SCIENTIFIC AMERICAN

JUNE 7, 1913

From a Painting by Gerrit A. Beneker

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Inventors' Contest.

Tractors for the Small Farm.

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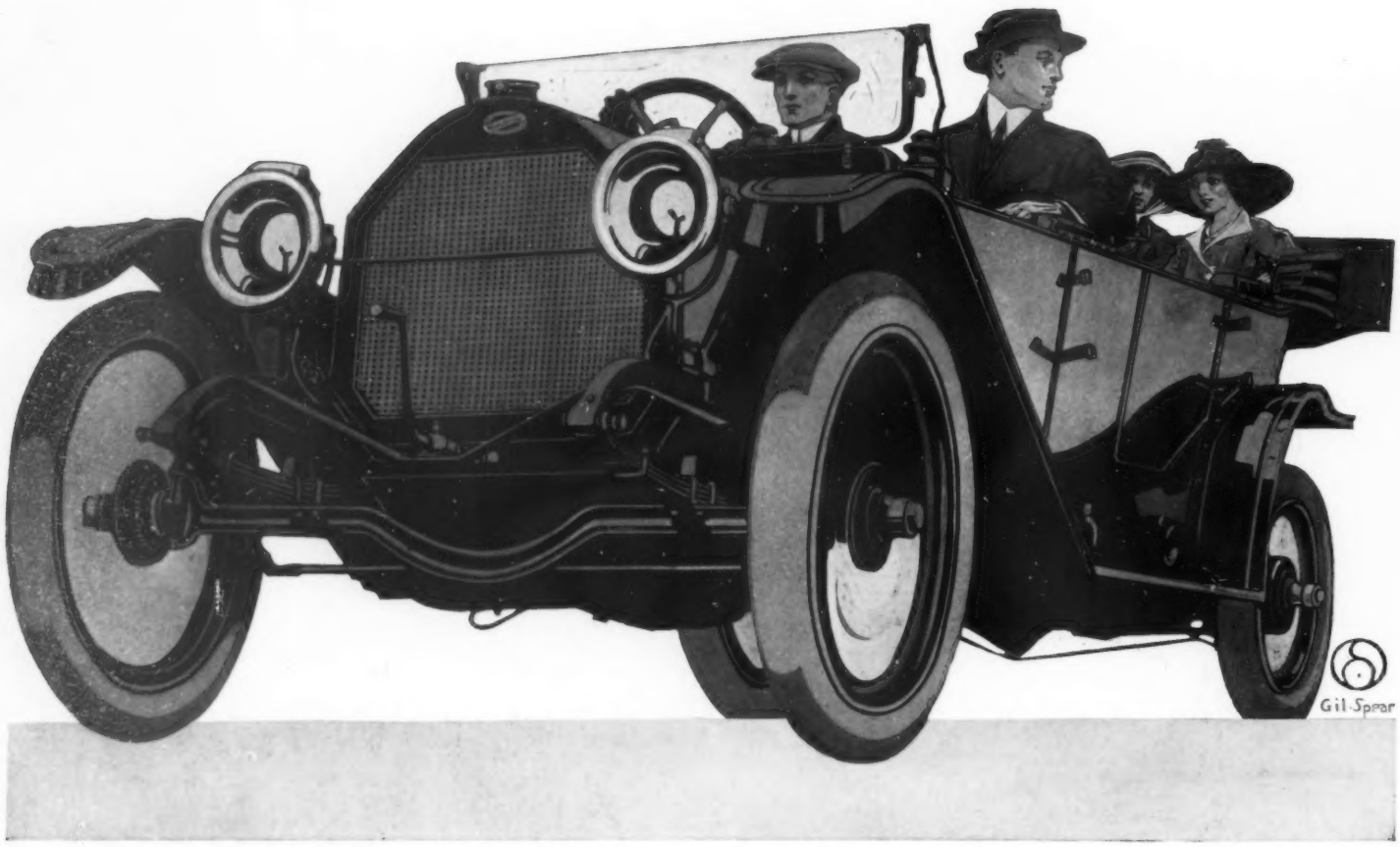

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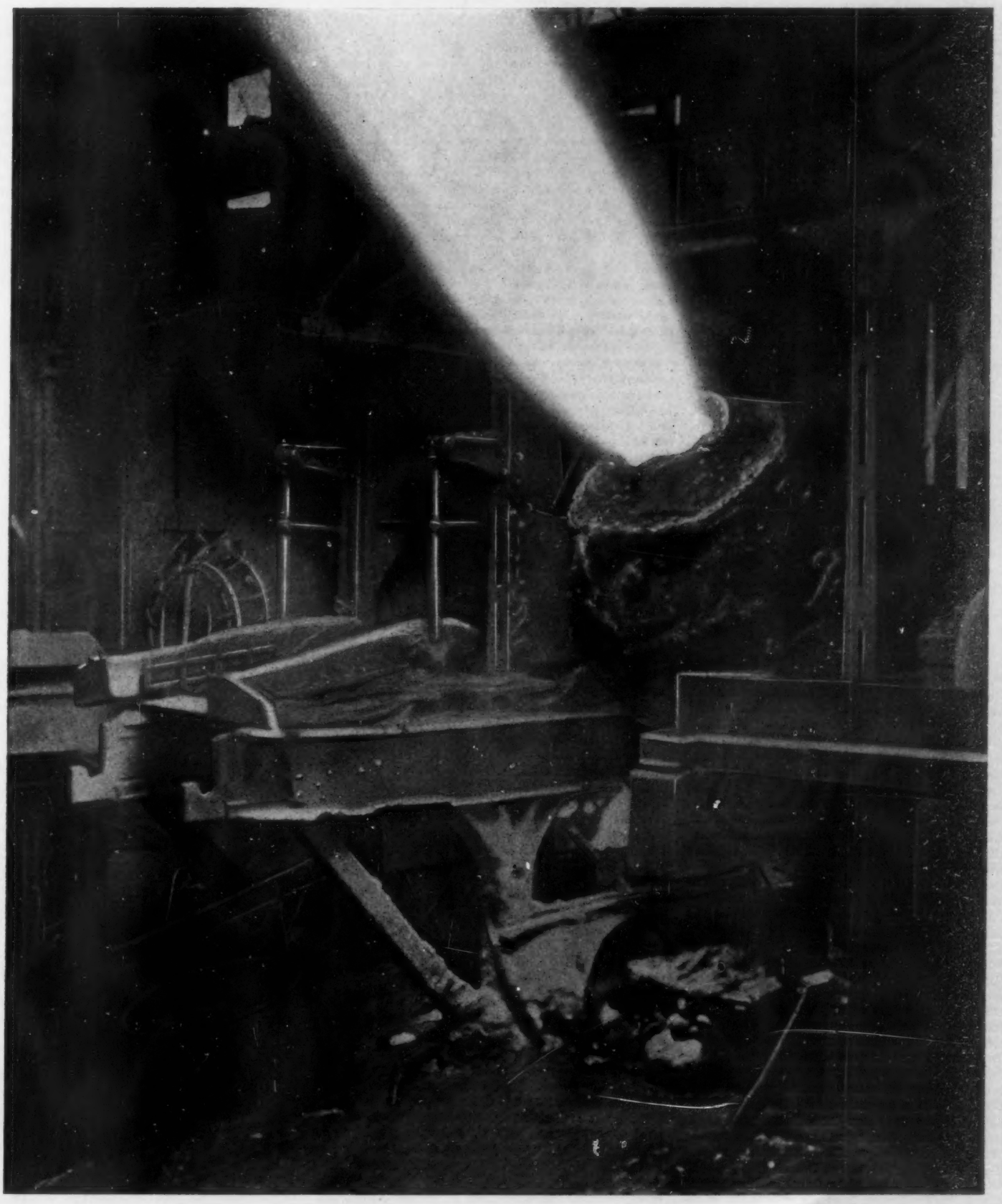

BLOWING A HEAT IN A BESSEMER CONVERTER.—[See page 516.]

SCIENTIFIC AMERICAN

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

Price Maintenance and the Supreme Court Decision

FORTIFIED by numerous decisions of the lower United States Courts, manufacturers of patented articles have been led to believe that the "exclusive right . . . to vend" an invention, conferred on patentees by our laws, could be interpreted to mean the right to fix the price at which the invention was to be retailed. The Supreme Court of the United States has now decided that when he parts with the title to merchandise embodying his invention, the patentee may not enforce restrictions intended to prevent the buyer from selling at any price.

We have no reason to question the legal wisdom of this momentous decision. But business men will surely voice another strong protest against a system of legal procedure which has only at this late day enabled them to learn the definite meaning of the words "exclusive right . . . to vend." A less cumbrous and expensive court procedure would have given them this important interpretation fifteen years ago, at a time when the relation of price maintenance to distribution first dawned on them, and when they had not yet spent millions and millions in advertising the price at which their safety razors, fountain pens, cameras, and vacuum cleaners could be bought in every country town.

While the Supreme Court doubtless interprets the patent statute fairly, its decision drives home once more the lamentable fact that law and its administration have lagged behind merchandising and its methods. "Let the buyer beware" is still a judicially recognized legal maxim, although it is nowadays considered an abhorrent principle in honorable merchandising to cast all the risk of a sale on the purchaser of an article. "Protect the buyer" is the modern merchant's maxim; but his efforts to make that maxim effective, something more than a moral precept too elevated for the observance of the lowly shopkeeper, are seriously hampered by decisions such as this of our Supreme Court.

No one who is at all familiar with the difficulty of distributing goods efficiently or with the transformation of selling methods brought about by world-wide advertising, supposes for a moment that the resale prices of patented wares will no longer be fixed. Fairness to the public and to himself will compel the merchant to devise selling systems which will prevent the "cut-rate" chain and department stores, and the huge mail-order houses, from devouring the small retailer's restricted market. The methods adopted by the vendors of trade-marked articles, who had nothing akin to the patent statute to protect them from attacks under the Sherman act, will no doubt be adopted by patentees. Goods will be consigned instead of being sold; agencies will be created; preferential discounts will be given to those who maintain the prices marked upon packages and withheld from those who depart from them; private detective services will be established to unearth price-cutters and their sources of supply. In a word, a dozen different stratagems will be evolved to carry out a well-established, necessary and honorable business practice awkwardly and circuitously instead of efficiently and directly.

The Supreme Court's decision is of peculiar importance to inventors, because it vitally affects the established methods of introducing inventions. Every new device, great or small, means a revolution, great or small—a revolution in the way of building so huge a machine as a locomotive or in accomplishing so insignificant and personal a task as shaving one's face. Revolutions are not always welcome. The public must be taught to use the new, revolutionary invention. A whole lake of printer's ink, a veritable Niagara of advertising, was necessary to convince the world that a vacuum cleaner would actually suck dirt out of a carpet and that a piano could be acceptably played with mere air instead of hands. In interpreting the words "exclusive right . . . to vend," the lower Federal Courts seem to have taken these difficulties into consideration; for they have held that a part of the inventor's reward for having devised and frankly disclosed his fountain pen or his talking machine was the right to dictate the conditions under which his invention was to be used and sold. In other words, the expression "exclusive right . . . to vend" was given the broadest possible meaning by the lower courts. The Supreme Court has given them their narrowest possible meaning.

Years of patient, costly experimenting are required to develop an invention to commercial perfection after the grant of the patent in which it is disclosed. The monopoly which the inventor is supposed to enjoy is, in effect, much briefer than the seventeen years legally prescribed. It may be seriously questioned whether the generous idea of those who framed the Constitution—the idea, very novel one hundred and seventy-six years ago, of permitting the creator of intangible brain property to own it absolutely for a limited time and of actually encouraging inventors to devise new machines and processes—ought not to be definitely expressed in a patent statute which will in terms permit the patentee to exercise a reasonable control over his invention after it has left his hands.

The opposition to price maintenance engendered by the decision in the Dick case can be easily enough traced to a vague fear that in some way the practice of fixing retailing terms is akin to trust control. A long, tedious campaign of education will be necessary to dispel that fear, to teach the difference between controlling the market on *all* safety razors and the market on *one* particular safety razor, to prove clearly that the liveliest conceivable competition among makers of patented safety razors prevents any one of them from exacting an exorbitant profit. Many magazine and newspaper articles must be written in order to convince the public that the small retailer will be driven out of business if "cut-price" department stores and mail order houses are permitted to sell below cost or at a small profit a well known and meritorious invention to the creating and advertising of which they have contributed absolutely nothing; that this profitless selling destroys the manufacturer's market and ultimately compels the public to deal with the department store and the mail order house of the large city.

Already signs are not wanting that the dangers which lurk in permitting chain stores and mail order houses to crush small retailers by "trust" methods, are to be regarded as a distinct menace. Statutes have actually been passed in Missouri, Indiana, Wisconsin, Illinois, New Jersey, California, and South Dakota, all designed to prevent "cut rate" dealers from undermining the good name and market of a reputable manufacturer, from depreciating the worth of well-known, trademarked or patented products in general estimation, and from misleading the public into the belief that other less advertised articles, which they keep in stock, are sold at similar low prices.

In enacting these salutary laws, the States mentioned have but extended the well-established practice of the older European nations. Denmark, a country in which the rights of the small property holder and the small retailer are jealously safeguarded, imposes a heavy fine on the dealer who departs from the price fixed by the manufacturer, and compels him in addition to pay an indemnity. Germany regards the violation of a contract to sell at a certain price as an offense to good business morals. Belgium punishes the price cutter by compelling him to pay damages to the merchant whom he has wronged. France rigorously enforces the conditions of sale imposed by a manufacturer to prevent underselling. Thanks to the sharp protests of many thousand retailers, Canada has been so far induced to modify her equivalent of our Sherman law as to permit the maintenance of prices under conditions which will enable the retailer to exist.

So widespread is this movement to protect the small dealer and the general public, that we may prophesy the extension of the conception of unfair competition to prevent not merely the pirating of a valuable trademark and the theft of another's name and label, but the destruction of the good will and the reputation that great manufacturers have tediously and expensively established by much advertising. That extension may be effected either by Federal legislation or by judicial enlargement of the conception of unfair competition. But though the extension comes soon or late, the effective distribution of personally guaranteed and identified merchandise, whether patented or not, demands the maintenance of the retail price as a necessary and legitimate business principle.

Expedition to the Amazon

WHAT is described as one of the best-equipped exploring expeditions that ever left the United States has been sent by the Museum of the University of Pennsylvania to the Amazon valley to carry on ethnographical and geographical research. The party goes on a steam yacht, 132 feet in length but drawing only 6½ feet of water, so that it will be able to navigate the smaller tributaries of the Amazon for thousands of miles, through a vast territory that is now practically unknown. It is proposed to explore first some of the northern tributaries, which flow from the mountains on the borders of Brazil and the Guianas; next the region drained by the Rio Negro and its affluents; and finally an effort will be made to reach the isolated tribes inhabiting the enormous unexplored forests between the rivers Madeira, Trapejos, and Purus. In each case the steamer will proceed as far as possible up the rivers, and canoes will be used to reach the less accessible headwaters; ultimately, parties will land and penetrate the forests to the native villages. Meanwhile the party in charge of the steamer will carry on geographical and hydrographical surveys. Probably no inhabited region of the world offers a more completely virgin field for exploration than the interior of Brazil, especially as to ethnographical research; and it is expected that the material brought back by the expedition will enable the University Museum to prepare a unique exhibition illustrating the life of tribes that are to-day the most primitive and picturesque of savages. The party is led by Dr. William Curtis Farabee, the well-known anthropologist. Commander J. H. Rowen, U.S.N., is in charge of the yacht.

Evolution and Physical Law

THERE is a common saying that history repeats itself. But science refutes this popular dictum. For it is a fundamental law of physics that any real finite system never passes twice through the same state. Thus in a system comprising a number of bodies at different temperatures, a gradual readjustment will take place by conduction and radiation, in such manner that the distribution of temperature approaches more and more nearly to a uniform state. Never, under any circumstances, will the system, after such equalization has taken place, return spontaneously to its initial state. Time is unidirectional, the past irrevocable.

It is hardly necessary to point out that this is true in the world of living organisms quite as much as in the non-living world. But in biological science the unidirectional character of time has a significance of its own. For the history of a species of living organisms, its *evolution*, is the central problem of modern biology. That species undergo modification, evolution, in the course of time, hardly anyone would question at the present day. But what is the trend of this evolution? The answer is contained in the principle of the survival of the fittest: Evolution proceeds in such direction, that individuals and species less well adapted to existing circumstances give way to species better adapted to them. In the living, as in the non-living world, evolution proceeds from forms less stable to those more stable under existing conditions. The problem of discovering the physical law of evolution is eminently a problem of discoverying a law of stability, a law of equilibrium. In the physical world the condition of equilibrium can be expressed in the form of a maximum or minimum law. Thus, for example, for a purely mechanical system the condition for equilibrium is that its potential energy shall be a minimum. Similarly, for a system subject to irreversible changes, the condition for equilibrium is that the thermodynamic potential shall be a minimum. Is there a similar law applicable to a system in the process of organic evolution? Is there some function which continually diminishes as time goes on, ever approaching a minimum value? Many may have suspected the existence of such a law. Le Dantec in his book "La Stabilité de la Vie," has the boldness to express his conviction of the validity of such a law. But its full substantiation can hardly, as yet, be said to have been established, nor its exact form determined. There is scope for valuable work in this direction. A paper on "Evolution from the Standpoint of Physics," which appears in this week's issue of our SUPPLEMENT, represents an attempt to clear the ground for action in the attack of the problem. There is a small but growing body of workers in the field; a field somewhat difficult of access, because of the peculiar combination of qualifications and interests needed in those who are to cultivate it: A certain familiarity with at least the fundamental facts of biology; a readiness in the use of mathematical machinery; and above all, a thorough grasp of the laws of mechanics and thermodynamics in all their aspects.

Few men to-day combine such a combination of qualifications and interests, and hence, until a special body of workers has been trained especially for the work, progress in what appears to be a most fertile field for research is likely to be slow.

Engineering

Completing the Culebra Cut.—Two steam shovels working from opposite ends of the Culebra cut at grade met on the afternoon of May 24th. This, of course, does not mean that the excavation is completed, but merely that it has been carried down to grade. Considerable work must still be done to extend the canal to the required width.

Our Dangerous Streets.—During the year 1911, 532 persons were killed by automobiles in the streets of Greater New York. Incomplete records of the injured taken from daily newspapers show 13,042 persons hurt by automobiles, 704 by street cars and 317 by wagons. In London, which in 1911 had a population of over 7,000,000, 410 persons were killed by vehicles, while in Paris, with a population of over 2,000,000, there were 236 deaths and 18,179 injuries. by all classes of conveyances.

The Moffat Tunnel Through the Continental Divide.—At a recent election in Denver, Col., the Moffat Tunnel Amendment was carried by a large majority. This provides for a Tunnel Commission which will arrange for the construction of a six-mile tunnel through the Continental Divide for the Denver and Salt Lake Railroad. The eastern portal of the tunnel will be at Tolland, 35 miles from Denver. The tunnel will be 6.4 miles in length and its cost is estimated at between four and four and one half million dollars. It will reduce the route from Denver to Salt Lake City to 68 miles as against 187 miles by the Denver and Rio Grande route, which is at present the shortest. The tunnel will be open to all western railroads entering Denver. Eventually it will be bought over by the Denver and Salt Lake Railroad, but the city will retain perpetual rights to carry water power through it. Work will be commenced at once and it is hoped that the tunnel and the Denver-Salt Lake Railroad will be completed in 1915.

International Engineering Congress, 1915.—In connection with the Panama-Pacific International Exposition, which will be held in San Francisco in 1915, there will be an International Engineering Congress, in which engineers throughout the world will be invited to participate. The congress is to be conducted under the auspices of the following five National Engineering Societies: American Society of Civil Engineers, American Institute of Mining Engineers, the American Society of Mechanical Engineers, American Institute of Electrical Engineers, and the Society of Naval Architects and Marine Engineers. These societies, acting in co-operation, have appointed a permanent Committee of Management, consisting of the presidents and secretaries of each of these societies, and eighteen members resident in San Francisco. The scope of the congress has not as yet been definitely determined, but it is hoped to make it widely representative of the best engineering practice throughout the world, and it is intended that the papers, discussions and proceedings shall constitute an adequate review of the progress made during the past decade and an authoritative presentation of the latest developments and most approved practices in the various branches of engineering work. The papers, which will be collected and published by the congress, should form an invaluable engineering library, and it is intended that this publication shall be in such form and at such cost as to become available to the greatest possible number.

Aluminium and Magnesium Alloy.—In a paper read before the Society of Automobile Engineers, Mr. Morris Machol gives some interesting data on the aluminium and magnesium alloy known as "magnalium," and describes the successful use of this alloy for the cylinders and pistons of gasoline engines, particularly where weight is an important factor, as in aeroplane work. The specific gravity of magnalium is 2.5, that of pure aluminium 2.56, and of aluminium alloy No. 12, 2.82, while cast iron has a specific gravity of 7.5. Cast iron pistons show a tensile strength of between eighteen thousand and twenty thousand pounds per square inch, while magnalium shows a strength of twenty-three thousand pounds per square inch. It is also very tough, whereas cast iron is rather brittle. Magnalium is an excellent bearing metal, showing at 280 revolutions per minute and 250 pounds per square inch, a coefficient of friction of 0.0056 as against 0.0075 of babbitt and 0.0069 of phosphor bronze. With a pressure of 400 pounds per square inch, and the same speed, the coefficient of friction of bronze is 0.0096 as against 0.0066 of magnalium. One of the advantages of magnalium pistons is the remarkable reduction of vibration. The melting point of magnalium is 1256 deg. Fahr. at atmospheric pressure, which is less than the temperature often attained in the cylinder. But the magnalium pistons do not get as hot as iron pistons for the reason that the thermo-conductivity of magnalium is fourteen times as great as that of iron. An engine with magnalium pistons is less liable to pre-ignition than one with iron pistons.

Science

Searchlights for Airships are being tested in Germany. A dispatch from Berlin states that a naval airship which is to take part in the spring maneuvers will be fitted with a 40,000-candle-power searchlight capable of illuminating the surface of the sea from a height of 5,000 feet.

Dissociation of Calcium Carbide.—The increasing use of calcium carbide gives importance to all facts concerning its action under varying circumstances. M. Briner-Kurner at a recent session of the Academie des Sciences (Paris) proved that this compound was dissociated into its elements at a temperature of 900 to 1,000 deg. Cent.

Supplement to the Public Health Reports is the title of a new series of popular papers on subjects relating to health and disease, issued by the Public Health Service. Supplement No. 1, by Assistant Surgeon-General Rucker, deals with measles, which is described as a disease of much more serious import than is generally supposed.

An Interesting Subterranean River in the island of Palawan, one of the Philippines, has been explored and surveyed by two officers of the U. S. Coast and Geodetic Survey, and is described in the last annual report of that service. The river is navigable for a small boat for about 2½ miles from its mouth, the tunnel through which it passes widening in places into large chambers containing beautiful stalactites.

The Actinometer.—A useful invention in the field of technology is the actinometer, a description of which was presented to the Academie des Sciences recently by M. Daniel Berthelot. This little instrument permits the exact measurement of the ultra-violet rays of luminous bodies. By reason of the increased application of these rays, particularly for purposes of sterilization of water, etc., it is probable that this may prove to be of much practical value.

Natural Toothbrushes are described in a consular report from Santo Domingo. It appears that the stems of several shrubs and trees are used by the natives in lieu of toothbrushes, and are known as "chew sticks." Among them are the stems of the orange, the lemon, and the membrillo or quince tree, all of which have an agreeable flavor. The most commonly used, however, is a plant known as "guano," probably the same as the one called in Spanish "palma de guano." The natives use the green stem, the end of which they chew up and use as a toothbrush. Various chew sticks are similarly used elsewhere in the West Indies.

International Rubber Congress.—Preparations are being made for the International India Rubber Congress, which is to be held at Batavia, island of Java, in September of next year. A commission appointed for the purpose is now engaged in the preliminary work and is receiving the papers upon subjects connected with the rubber industry which eminent specialists are sending in. The work of the congress is divided into eight sections: 1. Botanical and zoological questions. 2. Climate and soil. 3, Culture and gathering of products. 4. Preparation and processes. 5. Methods of working plantations. 6. Artificial rubber. 7. Commerce. 8. Publications. Dr. C. J. van Hall is secretary of the congress, and the headquarters are at Buitenzorg, Java.

Death of Prof. William Hallock.—The recent death of Prof. William Hallock deprives Columbia University of its senior Professor of Physics. Prof. Hallock had an active scientific career. After graduating from Columbia University and the University of Wurzburg, he was physicist for the Geological Survey at Washington, where he also acted as Professor of Physics in the Corcoran School. From 1889 to 1892 he was Professor of Chemistry and Toxicology in the National College of Pharmacy. He also occupied for part of this time the chair of astro-physics at the Smithsonian Institution. He was connected with Columbia's Department of Physics from 1892 onward. Had he lived he would have been the official measurer of the yachts which will compete in September, 1914, for the "America" Cup. At the time of his death he was the official measurer of the New York Yacht Club.

The National Academy of Sciences will celebrate the 50th anniversary of its foundation at a meeting to be held at the National Museum, in Washington, April 22nd to 24th, inclusive. The programme will include quasi-public addresses by the president of the Academy, Ira Remsen; President Hadley, of Yale; Prof. Arthur Schuster, F.R.S.; Dr. Hale, director of Mt. Wilson Solar Observatory; Prof. Theodor Boveri, of the University of Wurzburg; and Prof. J. C. Kapteyn, of the University of Groningen. All the addresses will be in English. The National Academy, which is the premier scientific organization of this country, corresponding to the Royal Society in Great Britain, the Academie des Sciences in France, etc., was incorporated by act of Congress approved March 4th, 1863; its principal function being, as defined in the act, to furnish advice to the government "upon any subject of science or art." The initial meeting was held April 22nd, 1863, in the chapel of the University of the City of New York. It now has a membership of 120, besides 45 foreign associates.

Automobile

The Small Boy and the Horn Button.—There are few things that can be more annoying than the small boy whose eagle eye never fails to search out the button for the electric horn and whose finger unflinchingly presses it to the accompaniment of a raucous blast that startles pedestrians almost out of their wits and draws unnecessarily on the battery. In appreciation of the fact, one manufacturer of a high-priced car has hit upon the novel scheme of concealing the button beneath the leather of the upholstery. The owner knows where the button is, but no one else can even suspect its presence, for the wires leading to it also are concealed.

Motor Spirit from Living Plants.—Because the supplies of both crude oil and coal are more or less limited and are impossible of regeneration, a British chemist rises to remark, quite logically, too, that the better way to solve the impending fuel problem is to obtain motor spirit from living plants. Potatoes, beets and allied vegetables, consisting largely of starch, are capable of fermentation and yield alcohol. It would seem, therefore, remarked the chemist, that the soundest solution of the problem is to be sought along the lines of the production of fuel from some living plant which assimilates carbon by photosynthesis, thereby avoiding the exhaustion of the source of supply.

Unusual Application of a Fan Brake.—For use in the mountainous parts of Switzerland, a car has been developed in which the usual brakes are supplemented by a large fan brake placed beneath and parallel to the chassis. When descending heavy gradients, the fan is placed in motion, thus causing a large displacement of air and materially retarding the car while at the same time the draft serves to prevent overheating of the rear wheel brakes and of the differential mechanism. The fan is so arranged that it can be driven through any one of the four speeds obtainable with the gear set and the blades are adjustable to provide greater or less retardation according to the steepness of the grades negotiated.

A New Road Material.—A new road material designed to stand hard usage from automobiles is being tried by a Swiss engineer, W. Erlich, and is said to consist of a mixture of broken stone about the size of a hazelnut, but not limestone, with a binding material whose composition is not divulged by the inventor. In the present process the stone is heated at first from 100 to 150 deg. Cent. and mixed at this temperature with the melted composition. When in use, the mass is remelted in order to put it on the road. A road roller heated to a rather high point is passed over the surface, the roller weighing about six tons. Reports state that very good road surface can be obtained in this way.

Influence of Engine Starters on Design.—It is interesting to note that the widespread adoption of engine-starting apparatus operating through gearing cut in the periphery of the flywheel has required the production of better flywheels. The gearing cut on cast iron flywheels scarcely can be expected to wear for any length of time and hence steel has come into more general use for the purpose. The alteration can be expected to raise the already high factor of safety, for though the bursting of flywheels is a rare occurrence, it is a matter of comparatively common knowledge that the rim speed of the ordinary touring car flywheel frequently exceeds the safe limit and in fast roadsters the occurrence is very common.

The Cyclecar in America.—It is doubtful if that hybrid vehicle which abroad is styled "cyclecar" for the want of a better name, ever will prove popular in America. In the first place, the American tendency is toward greater carrying capacity, whereas the cyclecar accommodates only two passengers, but what is of even greater importance, American roads are not suitable for the little vehicles. Foreign roads, as nearly every one knows, are, in the majority of cases, veritable boulevards; there are no ruts. Outside of the big cities in America, however, ruts surrounded by mud are the rule rather than the exception. And as the cyclecar can neither straddle the ruts nor run in them, either of which is necessary for some sort of comfort, it is very doubtful, to say the least, if the cyclecar ever will become popular.

Mirrors at Road Crossings.—Mirrors at road crossings for the use of warning automobiles are commencing to be used in England, it is stated, and the results are very good. They are being put in places where the crossings are specially dangerous, and the use of large mirrors allows the driver to see the reflection of cars which are coming in other directions. The method will probably be extended in the future, as it is likely to avoid many accidents and will be well worth the small cost of putting in. Another use for mirrors is upon heavy power wagons, where the driver cannot hear the signals of automobiles back of him so as to have him take the right-hand side of the road to allow them to pass, for the noise of the power wagon often prevents the horn from being heard. It is proposed to fit the power wagons with small mirrors showing the back of the road, but were this to be made obligatory, the mirrors might be imposed upon the usual automobile cars as well, and this would give rise to some objections from their owners.

The Screw Spike Versus the Cut Spike

The Tie and Rail Fastening in Their Relation to Safety of Travel

ALTHOUGH the typical American railroad track, when the ties and fastenings are new and the ballast is of good quality, proper depth and well tamped, is an excellent construction for its purpose, it is liable to very rapid deterioration, and unless the inspection is constant and careful, it very quickly begins to show signs of wear, and, if neglected, may rapidly degenerate into conditions dangerous to the traffic.

The present article has to do with the tie and rail fastening, and particularly with the latter. These have not kept pace with the great increase in the weight of trains and speed at which they are run. Except for the gradual introduction of tie plates, placed between the base of the rail and the wooden tie, in order to distribute the load and prevent the ties from being crushed down, the average American track to-day is the same in general type as it was fifty years ago. Its most glaring defect is the cut spike, which is nothing more nor less than a magnified nail—and it does not take the expert mind of the engineer to understand that nailing the rails which carry the heavy traffic of to-day down to a wooden tie is a practice that ought to have become obsolete many a decade ago. The cut spike is bad from whatever point we look at it. When it is driven down into the tie by the blows of a heavy sledge, it does not cut a clean, snugly fitting hole, but, instead, it tears its way through the fiber, producing the ragged hole, shown in one of the accompanying engravings. The result is bad in two ways: First, the holding friction between the spike and the badly torn fibers of the tie is comparatively poor; secondly, the jagged hole thus opened into the tie favors the entrance of water and tends to set up a rotting action, which soon robs the tie of its already limited holding power.

In cases where the rail rests immediately upon the wooden tie, and to a less degree where tie-plates are interposed, the heavy loads of modern traffic tend to work the rail-plate or the tie-plate down into the tie and away from the head of the spike. Moreover, the general elasticity of the rail, ties and ballast, causes the wheels of the train to produce a wave-like action which gives to the rail at any particular point a powerful vertical movement. The rail is first depressed and then, by its own elasticity or by the wave-like action, returns to or above its original position, pulling the spikes with it, and leaving them in time, with the head from one to as much as two inches above the base of the rail. This condition in one of its worst forms is shown in one of our smaller illustrations. Some of our more progressive railways have recently begun to adapt the screw fastening which has been common practice on European railroads for a long period of years. In some cases the screw spike is screwed down into place without boring of any preliminary hole, but the best practice is to bore a hole smaller than the spike, and then screw the latter firmly down into position with its head bearing snugly on the base of the rail. We present an illustration of a screw fastening which is being used on the Harriman roads with great success, in which the holding power of the spikes is greatly increased by first screwing down into the tie a helical steel lining, of the same pitch as the threads of the spike, which are engaged by the threads when the spike is in place. This device provides a greatly enlarged area of resistance against shearing, and it is particularly valuable when the softer woods are used.

The great superiority of the screw over the cut spike was demonstrated by some tests made at Columbia University by Prof. Ira H. Woolson. In these pulling tests, it was demonstrated that the maximum resistance of cut spikes driven, without boring, into seasoned oak ties was 5,160 pounds and the maximum resistance of screw spikes was 13,530 pounds. The tests of Hardy Catalpa wood shows the maximum resistance of cut spike for twelve tests was 5,000 pounds and for fourteen tests of screw spikes the maximum was 9,440 pounds. Four and five tests respectively of seasoned chestnut gave 3,220 pounds resistance for cut spikes and 11,150 pounds for screw spikes. Forty tests of seasoned loblolly pine gave a maximum resistance for cut spikes of 6,250 pounds and for screw spikes, 13,710 pounds.

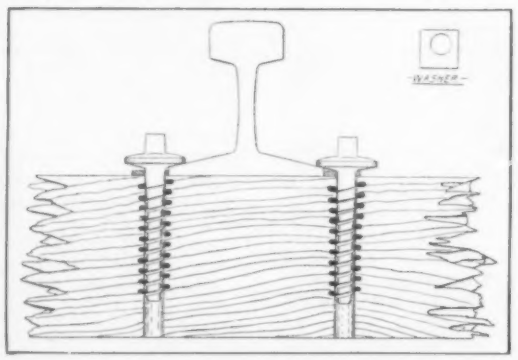
The superior results with screw spikes as thus obtained in the laboratory have been confirmed in actual service in the tracks.

These spikes have been partially drawn by vertical working of the rail.

Crushed and splintered ties, found by Interstate Commerce Commission at scene of a derailment.

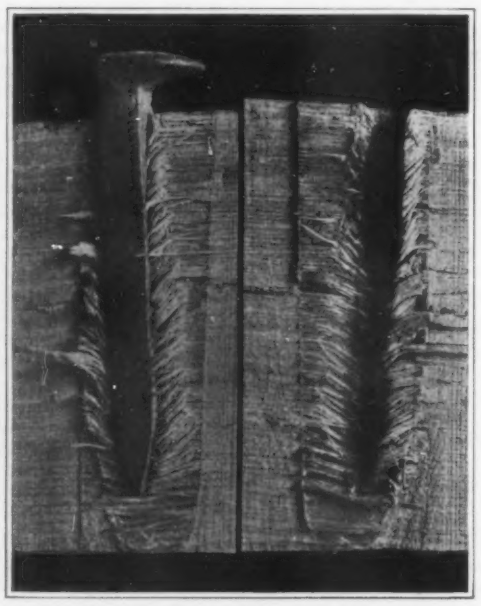
"Shims" between rail and tie destroy holding power of spikes.

How rail spikes are drawn by the vertical movements of rail.



Section through a portion of a railroad tie showing the bored hole, helical lining and screw spikes in place.

Section of tie, showing helical lining as used with screw spikes on the Harriman lines.



Section showing the brutal tearing of tie fiber by driving cut spike.

The Color of Cocoons

THE color of the cocoon produced by certain Lepidoptera is the object of researches made by the German scientist, Dewitz. In the case of the *Hasiocampa quercus*, he observes in the case of a caterpillar kept in a tin box, that about 8 or 9 o'clock A. M. it prepares a gray cocoon formed of silk and a certain number of hairs, and it is only about 2 o'clock P. M. that it commences to saturate the cocoon with a creamy liquid which solidifies and renders the cocoon hard and durable. Making a small opening, he is able to see the caterpillar spreading the liquid on the inside with its mouth, so as to be absorbed throughout the whole mass. The finished cocoon is of a light gray hue, but if this is now taken off, the caterpillar commences to make a second one, in which the silk is entirely white, and this is due to the fact that the provision of liquid has now been exhausted, so that no more can be put on and the cocoon remains in its original state. It should also be remarked that in the case of the first cocoon, after saturating it with the liquid the caterpillar then lines it with a white silk, which remains in the natural state in all cases. Such cocoons when placed in water become black, and the water takes a brown hue. He also notices that the moisture of the air causes color changes, and the cocoon is almost black in damp air, but remains a light gray in dry air.

How to Clean Brass

TO clean brass furnishings or to remove fly spots or tarnish from them they should be boiled for a few minutes in a solution of one ounce of alum to every pint of water. After boiling they should be polished by some brass polish or just a dry cloth. This will remove tarnish from all crevices where other means fail.

Lifeboats Which Can Be Launched on Either Beam.

UNTIL the time arrives when ocean-going steamships are so fully protected against sinking that every ship can act as its own lifeboat, it will be necessary to stow sufficient lifeboats to take care of every soul on board. As compared with present conditions, this involves carrying twice and in some cases three times as many lifeboats as are now carried on some ships. Where such an increase is made, especially in the largest vessels, the problem of stowage and the getting of the boats to the side of the ship becomes a very difficult one.

At the time of the loss of the "Titanic," the SCIENTIFIC AMERICAN, in its issue of April 27th, 1912, published a study of this problem in connection with the ill-fated ship, in which it was shown that by stowing the lifeboats athwartship and dispensing with some of the deck structures, it was possible to provide for fifty-six lifeboats instead of the twenty that the ship carried. It was suggested that in order to be able to launch the boats on either side of the ship, that is to say, to whichever side she was listed, the boats should be mounted in boat-skids or cradles, running in grooves sunk in the deck of the ship.

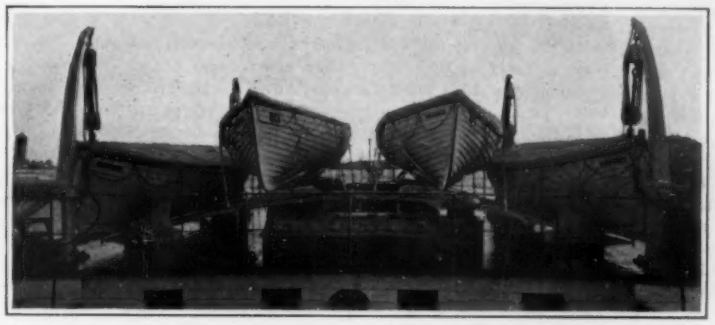
We have been much interested to learn that the large Flushing Royal Mail steamers of 3,000 tons, owned by the Netherland State Railways and running on night service from Folkestone to Flushing, have for the past five years been making use of this method of carrying and handling lifeboats; and we present the accompanying illustrations, showing how the boats are stowed and launched. The ships of this company make it a point to provide sufficient lifeboats to accommodate every person on board. This calls for a larger number of lifeboats than it would be possible to carry conveniently in davits along the side of the ship and, consequently, some of the boats are carried amidships in the manner shown in the accompanying engraving, which represents one of the deckhouses, with four boats mounted above the level of its roof.

The two outer boats at the side of the vessel are mounted adjacent to the davits; the other two boats are mounted on movable boat-skids, which are arranged to travel on a curved rail which spans the deckhouse from side to side of the ship.

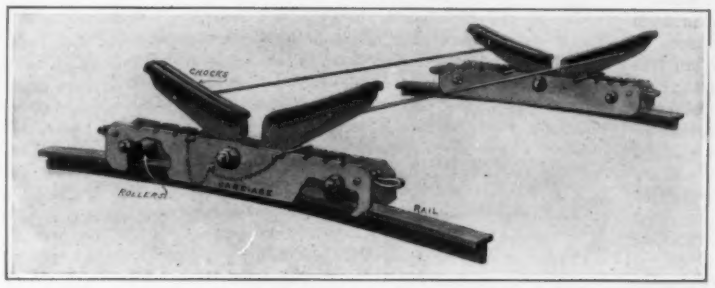
The V-shaped boat chocks are mounted pivotally on the center of the movable skids; the top edges of the two plates which form the sides of the skid are arranged to receive eyebolts, which are placed in such position that the boat at whatever part of the rail it may be stowed and made fast will rest in a vertical position.

It will be evident from a study of this arrangement that when the center boats are to be launched, all that is necessary is to undo the lashings of the skids, make fast the davit tackles, and slide the boat to port or starboard, where it is hoisted, swung outboard, and lowered. The arrangement permits all four boats to be lowered on whichever side of the ship is advisable, this, of course, being in every case the side toward which she is listed.

It should be noted that any obstacles on deck, such as hatchways, are easily overcome by building the rails above the same. In practice it takes the crew fifteen minutes to transfer half the boats from one side to the other, and to lower all the boats into the water over one side. The device was worked out by one of the company's officers and it was awarded a gold medal as an improved life-saving device by the Exhibition of Safety which was held at the Hague in 1908.



Boats of the Flushing Royal Mail steamers as arranged for launching on either side of ship.



Details of the rails and boat skids.

Echoes of the Andrée Expedition

BUOY NO. 10 of Andrée's ill-fated balloon expedition in the Arctic was found last September floating off Prince Charles Foreland, west of Spitsbergen. Discussing this event in the Swedish journal *Ymer*, in connection with the previous discovery of buoys Nos. 3 and 8 on the southwest coast of Iceland, Dr. Nathorst concludes, in view of the known course of the currents, that all three were thrown over somewhere to the southwest of Franz Josef Land. From all the remains, it seems certain that the course of the balloon was first northeast; then, after a westward loop, easterly. The final catastrophe seems to have occurred between Franz Josef Land and Nova Zembla.

Making the Aeroplane Safe by the Gyroscopic Stabilizer

By Robert G. Skerrett

IT is commonly recognized to-day among aviators and the builders of flying machines, that stability is the quality most to be emphasized in order to insure greater advance and wider adaptation of the aeroplane. This stability must be either inherent or so responsive to automatic control that the pilot shall be subjected to a reasonable minimum of executive nervous stresses.

As we know, Monsieur Gustave Eiffel and his distinguished collaborator, Engineer Drzewiecki, have produced the "aerostable," a combination of tandem wings which, through their measure of opposite impulses, tend to establish automatically a resultant stability in the machine which is mutually supported by them. This, in brief, constitutes the element of inherent stability by which an aeroplane of that design is steadier in flight and not so apt to tip vertically, i. e., fore and aft, because of gusty conditions of the wind prevailing at the time.

But the aerostable is only a partway solution of the problem of longitudinal stability and has nothing to do with the lateral aspect of the question, which is undoubtedly the more difficult to meet. The most successful efforts to deal with these two departments of aeroplane stability have been those of Mr. Elmer A. Sperry, who has been experimenting in conjunction with Curtiss machines for more than a year. Recent trials at the Curtiss camp at San Diego, California, have demonstrated the correctness and the efficiency of Mr. Sperry's gyroscopic stabilizer.

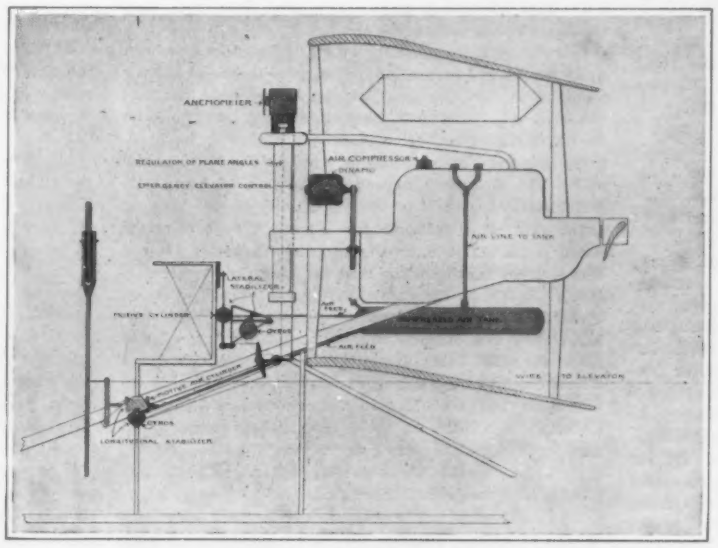


Diagram of the Sperry gyroscopic aeroplane stabilizer.

The gyroscope as a stabilizer for aeroplanes is not, in itself, essentially new, but the manner in which Mr. Sperry employs its corrective agency is a novel one. In the present apparatus this measure of safety control is not entirely the result of the functioning of gyroscopes, and this departure is one of the ingenious features of the installation. He employs a tempering mechanism which overcomes one of the serious defects which characterized earlier stabilizers using the gyroscope, pendulum, or other inspiring medium tending to maintain horizontality. We shall appreciate the value of this modification presently.

In our illustration of the vital mechanisms of a hydro-aeroplane, the rectangular disk is the exposed surface of an anemometer. Its duty is threefold. First, it furnishes a visible record at every instance of the speed of the aeroplane; it catches the machine when rising too slowly and starts the flyer upon a life-saving volplane before there is danger of its sliding backward; and it also serves to regulate the angle of the various maneuvering planes, so that the amplitude of their steering effect will just suit the speed of flight at any moment.

When climbing, the aviator ordinarily knows next to nothing about the actual rate of his progress. The nose of the aeroplane points upward and his engines may be working smoothly, and yet the very angle of his rise may cause the aeroplane to slow down dangerously close to the critical speed at which the air fails to sustain the machine. Before he knows it, the flyer starts slipping backward, and well nigh instantly the aeroplane is falling uncontrollably earthward, tail first. Let us see how the anemometer comes to the rescue.

When the wind pressure on the little disk registers within a few miles of the speed of minimum buoyancy, the anemometer brings into play a small electrical apparatus termed a servo-motor, which operates a shaft leading to the lever in the system of longitudinal control. This shaft does two things: first, it shifts the fulcrum so that the pilot cannot operate the lever, and then it functions the lever itself through the medium of compressed air in such a manner that the aeroplane is made to turn its nose earthward a number of degrees, thus starting the machine automatically upon a gliding descent. This impulse is sufficient to bring the velocity of flight well above the critical point, and in this way the aviator is warned of the danger that was near and correction provided simultaneously. Ignorance of this peril has probably been responsible for a number of distressing accidents. In this particular operation, the gyroscope is not an essential associate.

Ordinarily, however, the gyroscopes exercise automatic surveillance over stability, both in the horizontal and the vertical planes, by regulating the flow of compressed air to the operative cylinders. In principle, the arrangement is rather simple. The motive cylinders are attached to the same cranks or levers that can be worked by the pilot's hands or the lateral swing of his body against the yoke attached to the back of his seat. The hand wheel in front of him functions the vertical movement of the nose of the machine, while the lateral throw of his body corrects or guides the horizontal tipping. Both of these operations are subject to his will so long as he presses an attachment on the steering wheel, and he can maneuver the machine quite independently in this manner, despite the action of the stabilizing gyroscopes. But, when he does not will to supersede the guardianship of the gyroscopes, then they take over the command of all lateral and vertical movements on the part of the aeroplane, and experience has amply demonstrated that these little spinning wheels are far more alert than the most skilful of aviators.

The way the gyroscopes work is as follows: when a disturbing impulse in the form of a wind gust hits any part of the system of guiding planes, the gyroscopes whose duty is to provide a remedy, move in opposition, and in thus swinging they actuate a wonderfully delicate balanced valve in the air supply line, and motive energy is accordingly fed to the proper cylinder, the piston rod of which pulls or pushes the required lever to which the wires are attached that run either to the ailerons or wing tips or to the plane at the end of the tail. But these gyroscopes have no quantitative discrimination and would cause the planes to move through a given angle, no matter whether the flying machine were going fast or slow. In other words, if traveling at a high velocity, this effort to stabilize would probably produce violent motions that might throw the

pilot out of his seat and do harm when really intended to help. It is here that the anemometer comes again into play. By continually shifting the fulcrum of the intermediate cranks or levers it qualifies the measure of the angular movement, either of the ailerons or the elevator at the tail, and thus an easy steering or corrective action follows, the wind pressure on the face of the sentinel anemometer prescribing the amplitude of the movements of the necessary planes.

The electrical impulse for the spinning gyros is obtained from a little dynamo driven by a belt from the forward end of the crank-shaft. This motor weighs only a few pounds, and should the engine stop, there is held in reserve sufficient power for operative purposes, for a short while, in a storage battery. This energy would meet all requirements incident to a descent, and is automatically thrown into service when the engines halt. The manner in which this dynamo is constructed makes it possible to generate both direct and alternating current, and the latter is available for wireless telegraphy without the weight incidental to a separate installation for that particular service. Compressed air is cleverly obtained by a small apparatus attached to the head of one of the cylinders. It catches the impulse of an explosion at the instant following ignition, and a nicely adjusted check-valve prevents any of the explosive mixture reaching the air tank. In this manner, the reservoir is kept charged at the desired pressure, and a sufficient reserve is maintained, so as to provide motive energy for the stabilizing equipment for a reasonable time after the engines cease to work.

The previous difficulties with stabilizers has been that they dangerously hampered the independence of the pilot. Mr. Sperry, however, leaves the airman free to exercise control or to turn the task of stabilizing over to the apparatus in the interim, the aviator being superseded in command only when through ignorance or inattention, danger is near. At San Diego, Mr. Sperry's son and some of the Curtiss pilots have deliberately gone out over the water and tried to upset the stabilized machine, and in every case the apparatus has responded to the demand and functioned effectively. This not only means a material gain in military value, but it bears importantly upon the future use of the flying machine, either for sport or commercial service of one sort or another.

Aeroplane Accidents

SINCE the last fatal aeroplane accident in our Government service in which Lieut. J. D. Park lost his life, near Los Angeles, Cal., on the 9th of May, attention has again been invited to the large number of casualties which have followed aviation in our military service.

Some rather startling statements of percentages have followed, but before relying too much upon these it may be well to note that our misfortune in having a number of casualties occurring closely together, combined with the very small number of aviators which we have in our service, would greatly exaggerate our situation in this respect. A far more useful comparison might be made when we consider the average number of hours in the air and miles covered per aviator. It is admitted that the percentage of casualties in our service is high, since six of our officers have lost their lives, beginning with the sacrifice of Lieut. Thomas E. Selfridge in the preliminary trials of our first military aeroplane at Fort Myer, Va., in the autumn of 1908. When we examine our records in connection with the only other nation from which exact data are available (England), we find that our aviators average nearly twice the number of hours in the air and miles covered per aviator.

The data from France include pilots of all kinds, and consequently do not furnish a basis for estimate. If we consider simply percentage of losses, Italy is ahead of us in the mournful statistics, while England is very close. There is one thing which an examination of the statistics presents, and that is the greater percentage of casualties occur in the first few flying months, after which there is a marked falling off. This fact alone gives France a great relative advantage, since her officers have been under training for periods that average much longer than our own. Due to the exigencies of the service, very few of our officers have been available for long periods of training in aviation.

When it is considered that the United States has been able to furnish so few of her officers for this service, and that such modest equipment has been provided, the records of aviation in our service are causes for congratulation, rather than commiseration. Unfortunately, casualties are given much more prominent places in our publications than the praiseworthy achievements.

If we regard the latter, and recognize that aeronautics has risen to an important place among the great war establishments of all military nations, it will no doubt be admitted that it is worth the cost, regrettable as it may be.

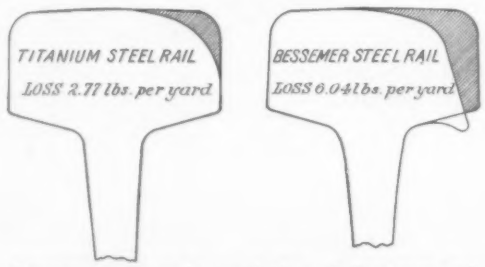
Ferro-titanium Alloy in the Manufacture of Iron and Steel

By Charles V. Slocum

THE physical characteristics and the uniformity of iron and steel have been remarkably improved by the use of titanium in the foundry. The titanium treatment tones up the endurance of steel against mechanical shock, friction and abrasion in railway rails, chilled car wheels, chilled rolls and the like, and enables high speed metal cutting tools to hold up structural steel.

The use of titanium alloy in iron and steel is of comparatively recent date. The successful manufacture of this alloy was achieved by Auguste J. Rossi, using the electric furnace (which has so many metallurgical feats to its credit) after many years of experimentation with other furnaces. Since being established on a sound basis by the aid of the electric furnace, the manufacture of titanium alloy has gone ahead by leaps and bounds, a single factory now having a product of 100,000 pounds daily. The year 1910 showed an output of 326,300 gross tons of titanium steel prepared by treatment with this alloy, and this very large product was increased to 410,600 gross tons in 1911.

The beneficial effect of titanium on steel is due to the removal of gases and solid impurities in the steel. These impurities, even though present in very small amounts, mask the physical characteristics of the metal, causing it to vary widely, even while showing sensibly constant chemical composition. The titanium treatment is applied to the molten metal in the foundry and the action of the titanium is essentially a cleansing one, based on the fact that titanium is a very powerful deoxidizer, with a strong affinity also for nitrogen. Added to steel containing deleterious oxides and occluded gases, the titanium greedily and searchingly combines with the foreign substances, developing compounds which are expelled as a very fluid slag and leaving the metal itself pure, clean and dense. The



Comparative wear in equal time of Bessemer and titanium rails.

alloy may be added in the ladle, preferably shoveled directly into the stream running from the iron cupola or steel furnace into the ladle, so that the lumps of alloy (resembling so much pig iron) are thoroughly churned up in the molten metal. It is important to mix the alloy in thoroughly, as it is much lighter than the fluid steel. After standing for a few minutes the ladle full of molten metal is poured into the ingot molds or into castings.

In railway rails alone the effect of titanium has been most striking because of the urgent need of better metal to support the great weight, high speeds and generally severe service in modern railway traffic. The accompanying illustration shows at a glance the beneficial effect in the lessening of wear on the head of the rail. The drawings are cross sections of two rails weighing 100 pounds to the yard, laid on the high or outer side of a railroad curve subject to continuous heavy traffic, and show the wear on the rails after a few months' service. The first drawing shows the original outline and the outline after the stated wear on a rail from titanium treated steel, and the second drawing shows the original and worn outline on a plain Bessemer steel rail. The treated rail in this instance has a considerably larger carbon content, but this increase is not essential to the success of titanium, although it should be noted that the titanium treatment so fluidizes the steel as to permit using comparatively high carbon that would, without the titanium treatment, cause brittleness in the steel.

What Are the Ten Greatest Inventions of Our Time, and Why?

A Prize Article Contest Open to All Scientific American Readers

THE November Magazine Number of the SCIENTIFIC AMERICAN is to be devoted in part to a review of the great inventions of our time. Because a large number of SCIENTIFIC AMERICAN readers are either inventors or users of inventions, it seems to the Editors that their judgment of the inventions produced in our time which deserve to be called the greatest, their appraisal of the relative importance of the paramount technical achievements of our day, would be of peculiar value and interest. Therefore, it has been decided to leave the entire subject to them.

The publishers of the SCIENTIFIC AMERICAN offer three prizes of $150, $100 and $50, respectively, for the three best articles on the topic, "What Are the Ten Greatest Inventions of Our Time, and Why?"

Contestants for the prize must observe the following rules:

1. Each article must discuss and answer the following three questions:

a. What, in your estimation, are the ten greatest nventions produced within the last twenty-five years?

b. What are your reasons for this selection? Justify your selection in each case.

c. To what person or persons is the greatest credit due in the developing and perfecting of each invention which you have selected?

2. The entire subject must be covered in a typewritten article not exceeding 2,500 words in length, and must be treated as simply, lucidly and non-technically as possible.

3. In deciding what are the greatest inventions of our time, the contestants are limited to machines, devices and discoveries commercially introduced in the last twenty-five years.

4. Since the SCIENTIFIC AMERICAN is "the weekly journal of practical information," and its readers practical business men and inventors, the articles submitted should deal only with *patentable* inventions and discoveries.

5. In order to guide the contestant in deciding what is a great pioneer invention of our time, it is suggested that practical success and general usefulness to mankind be used as a test. A modern discovery may have been suggested long ago and its underlying theory even worked out mathematically, as in the case of wireless telegraphy, but nevertheless it falls within "our time," if it has been made generally accessible and useful within the last twenty-five years. But commercial success should not be the sole criterion. The flying machine has not yet added millions to the national wealth; but, for all that, it is a great invention of our time. Mere improvements on well-known and successful devices are not to be numbered among the great inventions of our time.

6. Contestants must not disclose their identity. Each article must be signed with an assumed name and must be accompanied with a sealed envelope, on which the assumed-name is written, and in which the real name and address of the author is contained.

7. Contestants must address their articles, accompanied by the envelopes containing their real names, to "The Invention Contest Editor of the SCIENTIFIC AMERICAN, 361 Broadway, New York city."

8. The articles will be passed upon by a Board of Judges, whose names will be announced in a future issue of the SCIENTIFIC AMERICAN.

9. The Board of Judges will receive only the articles submitted; the envelopes containing the true names and addresses of the authors will remain in the possession of the Editors of the SCIENTIFIC AMERICAN. When the judges have made their decision, the Editors will open the envelopes of the winning contestants and notify them of their success.

10. The decision of the judges will be announced in the SCIENTIFIC AMERICAN of November 1st, 1913. The prize-winning articles will be published in the order of merit in consecutive issues of the SCIENTIFIC AMERICAN, beginning with the issue of November 1st, 1913.

11. The Editors of the SCIENTIFIC AMERICAN reserve the right to publish in the SCIENTIFIC AMERICAN or the SCIENTIFIC AMERICAN SUPPLEMENT articles which have not been awarded prizes, but which are deemed worthy of honorable mention.

12. While contestants are not required to supply pictures with their articles, illustrations will be welcomed. If drawings are submitted, they need not be elaborate; the staff artists of the SCIENTIFIC AMERICAN will work them up for reproduction, provided the material supplied is intelligible. Do not send pictures torn from books and periodicals; they cannot always be reproduced satisfactorily, and their unauthorized reproduction may constitute a copyright infringement. If photographs marked "copyright" are sent, they should be accompanied with the copyright owner's written permission for their reproduction.

13. Members of the staff of Munn & Company, Incorporated, publishers of the SCIENTIFIC AMERICAN, and of Munn & Company, solicitors of patents, are excluded from the contest.

14. All articles will be received up to 5 P. M., September 1st, 1913.

Another Aeroplane Patent.—An aeroplane shown in a patent, No. 1,056,844, to John Thomas Simpson of Newark, N. J., comprises a frame for the aeroplane, together with a sustaining plane and a balancing plane, both planes being separately connected to the frame and having mechanism by which they may be moved from side to side to obtain stability.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

The Bow Rudder

To the Editor of the SCIENTIFIC AMERICAN:

Your issue of March 15th is just received here to-day, and shows a desultory interest in the bow rudder. I spent last summer on the Lake of Thun, and noticed that the fleet of seven steamers were all fitted with bow rudders. The wheel house contained two wheels, mounted one immediately abaft the other, their relative positions, fore and aft, denoting which rudder they controlled. These ships were legitimate river or lake steamers, not double-ended ferryboats, and were steered by the after rudder, on the lake. At Interlaken is a long canal into which the steamers ran forward. They were always backed down to the lake, and during that operation were steered by the forward rudder, which temporarily represented the stern. At Thun, where the lake empties and where the current is strong, the steamers are turned out in the lake and entered stern first, again using the bow rudder. At Thun there are two landings, in making one of which both rudders are used, a quartermaster for either wheel. This operation seemed to give a decided sidewise or broadside motion, which may have been the reason for it, the current past the landing stage being rapid.

Paris, France. WILLIAM H. BRADFORD.

Automatic Lighting of Light Buoys by Means of Selenium

To the Editor of the SCIENTIFIC AMERICAN:

An article in your issue of March 8th, entitled "Lighting Light Buoys by Wireless," is read with great interest, and the new application of the familiar "Wireless distant control" appears to be an improvement in this case over the old system of shore control of lights on buoys.

In practice, however, it will doubtless be found that additional complication is involved and a certain degree of reliability sacrificed; also the installment of wireless tuning and receptive devices in buoys will be an additional expense which will not meet with favor.

If it is the object to avoid the old system of shore supply and control to light buoys and further locate the source of power in the buoy itself and do away with the cable, the writer suggests that the buoy contain the necessary batteries, also a selenium cell and relay.

By this method we do away with not only the cable, but also with the proposed wireless apparatus, and have a purely automatic signal which will need occasional renewals and inspection.

It seems hardly possible that this application of the "selenium cell" is new; but since it appears a great simplification of the newly proposed German system, and since no mention of it is found, this idea is respectfully submitted and may be taken for what it is worth in the estimation of those familiar with the light-buoy problems.

The above system is, of course, applicable to many modification., for example, control by means of a ship or shore searchlight. A. KELLOGG SLOAN.

Brooklyn, N. Y.

Undamped vs. Damped Oscillations

To the Editor of the SCIENTIFIC AMERICAN:

My attention has been called to certain publications that have been made in your Journal of late in which the statement has been made that the result of the Navy test on radio-telegraphy, as conducted between the Arlington station and the cruiser "Salem," had shown very conclusively a marked superiority, in long-distance operation, of the undamped oscillations over the damped oscillations or, as it has generally been spoken of in the press in discussing these tests, of the oscillations from an arc generator as contrasted with those of a spark generator. While it is perfectly true that superior results, for given amounts of energy, were secured with the undamped oscillations, over those secured with the damped oscillations, the real cause of this superiority has not, I believe, as yet been noted in any of the press statements. I therefore wish to call your attention to the fact that this superiority was shown when using the Fessenden receiving apparatus supplied to the cruiser "Salem" as part of its equipment in connection with the spark equipment supplied by the National Electric Signaling Company. It was a fact well recognized by the engineers of the company that the heterodyne would work to its best advantage with undamped oscillations, it having been invented and developed for that specific purpose and later adapted to the spark type as well, and it was also well known by them that it supplied the best known receiving mechanism for undamped oscillations. This superiority was so great that after the first few days all other forms of receiving apparatus were abandoned by the Navy officials in their test with the undamped oscillations. The heterodyne receiving apparatus operates upon the principle of "beats" in which interference beats of adjustable frequency are produced between the incoming oscillations and those produced in a local circuit. It is thus possible, in view of the action being a resultant of two forces, one from the sending station, and one produced locally, to considerably increase the energy available for operating indicating mechanism for receiving the signals. It is also possible by adjustments at the local circuit to secure a pure flute-like musical tone of any desired pitch and thus allow the operator to select what best suits his ear. This note is written simply in the interest of accuracy in order that readers interested in this line of work may be made aware of the real cause of the superiority shown by the Government test.

Pittsburgh, Pa. SAMUEL M. KINTNER.

Submarine Mountains

To the Editor of the SCIENTIFIC AMERICAN:

It may be of interest to some of the readers of the SCIENTIFIC AMERICAN to know that there are mountains and volcanoes under the sea, the same as on the surface, one of which I will describe. While acting as second officer of the U. S. cable ship "Liscum," stationed at Manila, P. I., we were ordered to proceed to Malabang, and run a line of soundings from that place to Zamboanga. These are two important military settlements on the island of Mindanao, and it was the intention of the department to run a new cable between these two places. After leaving Malabang we steamed slowly toward Zamboanga, taking soundings every thirty minutes, keeping a record of same. The water gradually deepened from the time we left Malabang until we were off Lutahgang Point, where we got 800 fathoms, when the man in the crow's nest sang out "Shoal ahead." We immediately took bearings and fixed the ship's position on the chart, but did not see anything marked on the chart that resembled a shoal or anything like it, so we slowed down and proceeded, stationing a man at the lead, and when directly over the shoal spot we got six fathoms up and down from the bridge. It appeared to be a circular spot about 100 feet in diameter and of coral formation. We only got one cast of the lead when we were in deep water again, so we came to the conclusion that we had run over either a submarine volcano or mountain, for nothing short of a good-sized mountain or some other kind of submarine formation could give such soundings in two or three feet, as sounding a few minutes before we arrived over the shoal spot gave 800 fathoms taken with the patent sounding machine.

Cape May Point, N. J. ALBERT E. REDIFER.

Ignition Devices

To the Editor of the SCIENTIFIC AMERICAN:

The writer, a reader of the SCIENTIFIC AMERICAN for many years, has noted with interest the article, "Small Internal Combustion Engines on Land and Water," in the April 5th number.

The fifth paragraph in this article would lead one to believe that the high-tension magneto was the best ignition for stationary and marine engines and offered a complete solution for their ignition troubles.

You may be interested in knowing that from careful investigation, we find only about 40 per cent of the stationary and marine engines now being made are equipped with jump spark (high-tension) ignition, this including both battery and magneto. If engines already in service are counted, the make and break engines outnumber the jump spark three to one.

As your correspondent is no doubt aware, the principal reason for the adoption of the high-tension magneto on the automobile was the difficulty in timing four make-and-break igniters to operate in correct relation with each other and a common source of current. This objection does not hold good with a single-cylinder engine, which represents by far the majority of power units in the stationary and marine field.

As to the comparative efficiency, from a purely igniting standpoint, there can be no question but that the make-and-break is far the superior. The spark is more dynamic in character, and is hotter. The make-and-break system is most successfully used in connection with low-grade oils and gas-producer units, where the ordinary high-tension, jump-spark plugs rapidly short circuit by deposits of soot.

The most simple ignition device imaginable is a low-tension engine-timed alternating-current magneto. This machine has no commutator and brushes, no timer contacts like the high-tension magneto; it has a single winding on the armature, requires no coil, switch or other auxiliary apparatus, is built into the engine, thereby forming a part of same, and eliminates entirely the complications of battery or high-tension magneto ignition, and at the same time furnishes a vigorous spark suitable for igniting all kinds of low-grade fuels.

We can cite to you several instances where, since the advent of this type of magneto, manufacturers have abandoned the jump-spark system and gone back to the make-and-break. This is especially true on single-cylinder engines where the high-tension system has absolutely no advantage and, in fact, has several drawbacks. Of course, where there are a number of cylinders, the cost of the make-and-break igniter mechanism would be greater than the jump-spark magneto and plugs.

We believe after exhaustive investigation that it is the source of ignition that will eliminate the ignition problem in stationary and marine units. The high-tension jump spark has its field, but this field is certainly not in connection with small internal combustion engines, for many reasons. H. R. VAN DEVENTER.

Sumter, S. C.

Straightening the Mississippi River

To the Editor of the SCIENTIFIC AMERICAN:

Notwithstanding all that has been written by correspondents in the SCIENTIFIC AMERICAN opposing the policy of straightening the course of the Mississippi River, I feel confident that this method, together with a system of levees as advocated by the SCIENTIFIC AMERICAN, is the most practical of all the suggestions yet made.

The actual distance from Cairo to the Gulf is about one half the present length of the channel from Cairo to the mouth of the river. If this channel should be straightened to two thirds its present length, the pitch per mile and the consequent flow in miles per hour would be increased one half. The product of these factors gives us a theoretical capacity of discharge to the Gulf equal to two and one quarter times that at present. I am fully aware of the fact that theory and actual practice are often separated by real, or seemingly impractical, barriers. Great obstacles are, however, often overcome by Nature herself when directed by human skill, which in the present case may doubtless be applied so as to make the force of the current do the bulk of earth removal. For instance, a loop of the river may be cut out by digging a deep, straight and narrow channel through the alluvial soil to start the current, and if necessary may be further aided by building booms, coffer dams, etc.

This straightening of the course of the flood channel would surely be a long, gradual, and expensive engineering feat, but it would accomplish results for the lower Mississippi region far more effective than the reservoir schemes.

However, I believe that much of the real lowland should be allowed to be overflowed at each flood season.

Scranton, Pa. CHARLES H. FOGGETT.

Control of the Mississippi

To the Editor of the SCIENTIFIC AMERICAN:

I have read with considerable interest the letters that have been sent in on the flood problem. As the editor of the *Boot and Shoe Recorder* remarked in the May 3rd number, I am an amateur, but I hope I can see a little farther than some.

I will agree with Danville, Ind., on the reservoir proposition. Suppose there were a half dozen reservoirs in the Mississippi valley, where would the surplus water go in a flood like the one we had in this country in March? It would be all right if it rained only a few miles on each side of the river; then reservoirs would hold the dampness; but when the Mississippi drains one half—or nearly so—of the United States it is quite different. White Plains, N. Y., thinks that a dam every few miles on the Mississippi would cost only a few dollars. The channel would be in a fine shape with his dams. The old river would be one long string of rapids, which would benefit no one. And again, suppose the dams were there, would that keep the flood in the channel? No!

Littleton, Del., says it would be a snap to straighten the Mississippi. Yes, it could be done, but what good would it do? Say it is as straight as a string from St. Paul to the Gulf and wide and deep enough to carry the highest floods. How long would it stay straight? Until the first high flood came, or may be a couple of years, which I doubt. Why? Because on one side the bank would cave or a pocket would form. That would have a tendency to form a cross current, and slamming up against the other bank, out would go another pocket. So in a few years it would be as crooked, if not more so, than it is now. We will suppose again that the whole river flowed in a channel of rock. Littleton, Del., would be in the swim. Who ever heard of a "runway" for a flood? The Secretary of the Interior must have been thinking of muskrats or beavers, as these animals use "runways." Plattsburg Barracks, N. Y., should know that there is a slight difference between the Kaw River at Kansas City and the Mississippi. He asks if the channels of certain rivers have not been choked? The Kaw might have choked in 1904, but that is ancient history. He should keep up with the times. Everyone knows, or should know, that bridge abutments retard a river ever so little. Bridges go out only when houses and buildings form a dam, and then something *has* to go. It seems to me that dykes and revetting would be the best. It doesn't look fair to tax the land that abuts a river and not the plantation or farm back of it. If I lived five or more miles from a dyke I should be taxed to keep that dyke up. Then they would be built larger and better. I have no fool suggestions to give, as there have been too many of that kind sent in.

Thornville, Ohio. JAKE HITE.

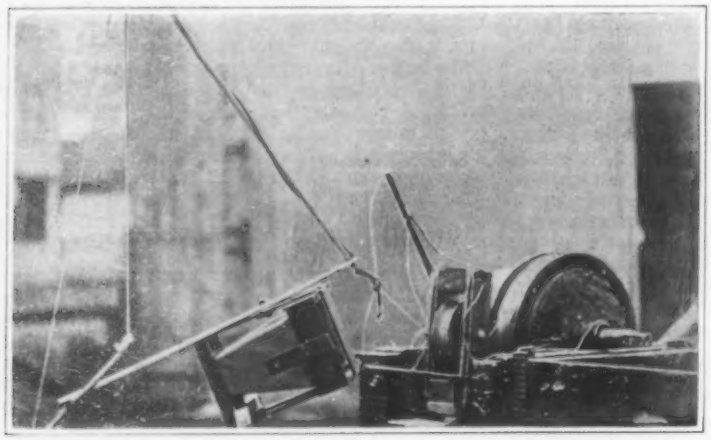


Fig. 1.—The kite reel and the camera attached to the wire.

Fig. 2.—View of Delmar, Iowa, from an elevation of 700 feet.

Photography from a Kite

By A. C. Gault

WITH the idea of awakening an interest in the fascinating pastime of aerial photography, the following experiences of the writer are recounted. It is hoped that they may prove of value as well to others who have tried to take photographs from the bird's point of view.

The kite which the writer employed is similar to those used by the United States Weather Bureau, known as their "moderate wind" type. It is illustrated in the picture showing the kite reel and other apparatus mounted on a rude home-made cart ready for transportation to the field. The kite contains 68 square feet of supporting surface, but I find it necessary to use a tail to secure sufficient stability to prevent blurring the picture. It is flown by means of a piano wire, No. 12, 0.029 inch in diameter. There is about three quarters of a mile of wire in the reel, but the kite would carry out more in a strong wind.

The camera is a specially constructed home-made affair, weighing, with a double plate holder, about two pounds, and taking a 5 by 7 picture. To prevent excessive oscillation it is secured to the kite string or wire, six hundred feet or more from the kite. Methods of connecting it to the wire are shown in Figs. 1 and 4. That shown in Fig. 4 is preferred. A description of it is hardly necessary, as it can readily be made out from the photograph. It will be evident that the bracket is universal, permitting the camera to be pointed in any desired direction. The photograph, Fig. 2, shows the town of Delmar, Iowa, as viewed from a height of about seven hundred feet. In making this exposure, the shutter was released by means of a piece of burning punk, placed in the aluminium box shown in Figs. 1 and 4, under the bellows of the camera near the forward end. This box was used to prevent the wind from extinguishing the fire. The length of time elapsing before an exposure was governed by the length of punk employed, which burned through a thread, thereby releasing a rubber band that sprang the shutter. In taking the photograph, Fig. 5, a clock mechanism was substituted for the punk and an improved carriage was employed for the camera. By this means the exposure could be made at any desired time and the camera could be pointed in any desired direction, by a few adjustments which could be made in a fraction of the time required by the other method. The details of this mechanism and the bracket are not disclosed in this article, for the reason that they have not as yet been perfected by patent. The photograph shows a stone quarry. The garage at the lower left hand corner looks rather flat. Note the creek in the upper part of the picture and the bridge at the extreme left, also the patches of snow, one at the foot of the hill and the other near the edge of the quarry, at the lower right-hand corner of the picture. The photograph was taken from a height of about three hundred feet.

Before meeting with any considerable success in kite photography, I made a large number of experiments in timing the exposures. A string attached to the camera shutter may be used when the camera is not high above the ground, but at any great altitude the pressure of the wind against the string is apt to cause a premature exposure. I have set off a camera by means of a traveler which sailed up the line and struck a projecting spar on the camera carriage, but this method resulted in blurred pictures, owing to the shock of the collision. I have also attached a sail to the camera and carriage allowing the whole apparatus to sail up the line until a projecting spar struck a piece of tin secured to the wire, when the exposure was made. The sail was then released and the camera slid down the line ready for another trip. But the pictures thus taken were very badly blurred, and the scheme was eventually given up after the camera struck the projection so hard as to be detached and hurled to the ground from an elevation of 1,700 feet. Fortunately, nothing was injured but the camera itself, although it fell right in town. Electricity has not been tried by the writer, as it calls for too great a weight of wire and insulation.

In spite of the experience of others who have taken photographs from kites, balloons, high buildings, etc., all of whom advised extremely short exposures, the writer has made dozens of exposures on bright sunshiny days, during the brightest part of the day, giving them one twenty-fifth of a second at F/8 or U.S.4, with absolute failure, although enough details were visible to show that the shutter had opened. This was true even with very rapid plates.

Fig. 3.—Kite and camera en route to the field.

Fig. 4.—The preferred form of camera bracket.

Fig. 5.—Looking down on a quarry from an altitude of 300 feet.

The Submarine Violin

THE Navy Department has adopted a "submarine violin" for the transmission of messages between submarine torpedo boats and shore stations or other vessels. Exhaustive tests of the apparatus have been made on a submarine at Hampton Roads, Va., and three sets of the signal device have been ordered to be placed on as many vessels.

The mechanism is an adaptation of the violin. From one side of the submarine project two steel stays. From the ends of these is stretched taut a piano wire. Touching the wire is the roughened rim of a wheel which, when it revolves, sets up vibrations in the wire. The wheel is controlled by a motor inside the hull of the submarine and the motor, in turn, is controlled by a Morse key. When the key is pressed the motor begins to revolve, the exterior wheel scraping the wire precisely as a bow agitates a violin string. The hull of the submarine acts as a sounding board. The key is used precisely as an ordinary Morse key and dots and dashes are hummed on the wire as the key is depressed and released. About eight words per minute is the best speed so far attained.

The receiving apparatus is the ordinary telephone receiver. The end under water may be connected by insulated wires to a fort, shore station or another vessel.

The experiments at Hampton Roads showed that the vibrations may be heard clearly at a distance of five miles. Naval officers believe that the device can be perfected so that the range of the mechanism may be greatly extended.

Christian Berger, an Austrian, is the inventor of the submarine violin. He attempted to get the Austrian government to make tests of it, but failed. Coming to the United States, he succeeded in convincing Navy Department officials of the practicability of the scheme.

The signal is a simple device and does not get out of order easily. It is available at all depths. It is expected to add not only to the ease of communication with submarines operating in harbors or in close proximity to war vessels in time of war, but will add materially to the safety of the men who go down in submarines, the most dangerous type of war vessel yet devised.

The Lima Geographical Society, one of the best-known organizations of its kind in South America, will celebrate the twenty-fifth anniversary of its founding on February 22nd, 1914.

A New Way of Making Artificial Diamonds

By the Paris Correspondent of the Scientific American

A PARIS engineer, M. E. de Boismenu, claims to have produced small diamonds by a new electric furnace method. It will be remembered that the late Prof. Moissan succeeded in obtaining very small diamonds (of microscopic size) in the electric furnace, but the process required special skill, and in any case the results were merely of scientific interest. M. de Boismenu employs a new principle, which has the advantage of being very easy to carry out in practice by a skilled operator. Moreover, the process will undoubtedly be further improved so as to secure larger specimens than those so far produced, which range up to 2½ millimeters in diameter.

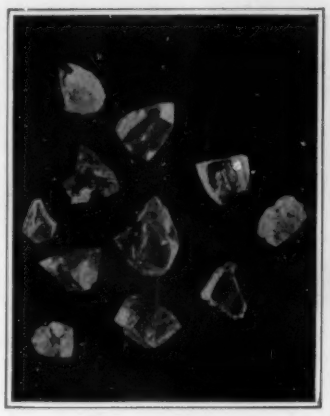
The inventor occupies a prominent position as director of an electric carbide furnace plant in France and conceived the idea that the diamond could be produced by electrolysis of a bath of molten carbide between the usual carbon electrodes.

The furnace used is built of refractory brick and has two carbon electrodes 6½ inches in diameter, one of which can be adjusted by hand. The bed of the furnace is first packed with a mixture of powdered lime and carbon, which serves to hold a trough shaped receptacle made of fused calcium carbide, as this is found best to hold the molten bath within the furnace. The carbons work within this trough, and are packed around with rather large fragments of carbide. By leaving the current on the bath of molten calcium carbide for a number of hours, an electrolytic action takes place by which the carbide is decomposed and the negative pole becomes surrounded by a black carbonaceous mass, in which are found embedded small crystals. These crystals answer to all the tests for the diamond.

The first conclusive operation was made on April 13th, 1908, in the inventor's experimental laboratory in the suburbs of Paris, using direct current from a small dynamo plant therein installed. After heating up the electrodes, they were drawn one inch apart, and calcium carbide was gradually fed in in small lumps, so as to produce a molten bath. The carbons were then gradually separated until finally they were 10 inches apart. The heat commenced at 11 A. M. and ended at 5 P. M. with a continuous run of 6 hours. The current used was 800 amperes at 34 volts. There were 8 pounds of melted carbide in the bath. At 3 o'clock a pile of carbide fragments were heaped upon the bath, and the whole was covered with a mixture of equal parts of lime and carbon so as to stop up the interstices, and finally the furnace was covered with two refractory slabs. The furnace ran in this way up to the end of the test, when the current was stopped and the furnace allowed to cool off over night. The scoriaceous mass resulting from this operation, weighing from 600 to 700 grammes, was placed in a vessel of water and allowed to remain over night. The residue was examined the next morning. During the night it had disaggregated in the water and formed a black mud, which was decanted and then slowly dried over an alcohol lamp. At once M. Boismenu's attention was attracted by small brilliant points standing out against the black background. He was able to pick these particles out by forceps and thus separated about a dozen of them. They appeared as small transparent crystals of somewhat irregular shape whose size varied from ½ to 1½ millimeters. Under the microscope they showed the characteristic appearance of diamonds. The specimens will scratch a plate of glass under very slight pressure, and the scratches are deep and remarkably clear; steel can also be scratched by them.

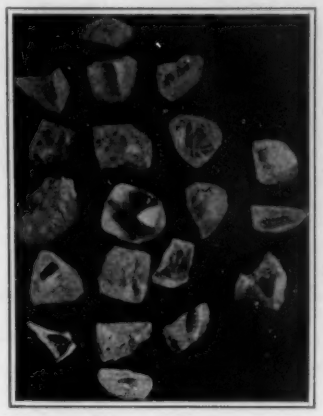
From April 20th to June 5th the furnace made fifteen runs, of which eleven were very successful. The last two of these, the furnace ran for 12 hours with 700 to 800 amperes at 24 to 25 volts, and some of the crystals reached one tenth of an inch in diameter. This seemed to be as far as one could go with the present small plant, and a new one will be required for further work. The specimens were submitted to two jewelers of Paris, who were unable to distinguish them from natural diamonds. One of the largest specimens could even be cut, and the author sent it to Amsterdam for the purpose. It was returned cut with thirty-two facets with remarkable dexterity.

M. Boismenu hopes to be able to continue his experiments in the near future, provided that funds are forthcoming for installing an electric furnace plant upon a larger scale. In closing, we should mention that the process has been patented by its author.

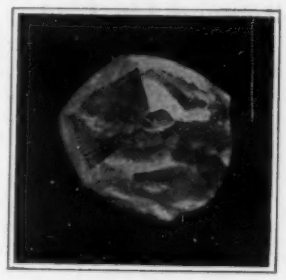


Diamonds obtained in a nine hours' run. Magnified six diameters.

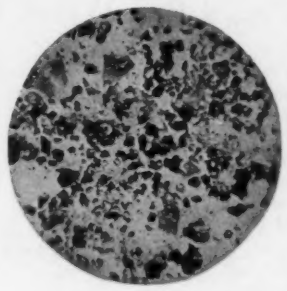
From ten hours' run. Enlarged nine times.



Some of the results of a twelve hours' run. Enlarged six diameters.



Diamond obtained on June 3rd. Englarged fifteen diameters.



Scoriaceous furnace product in which diamonds are found embedded.

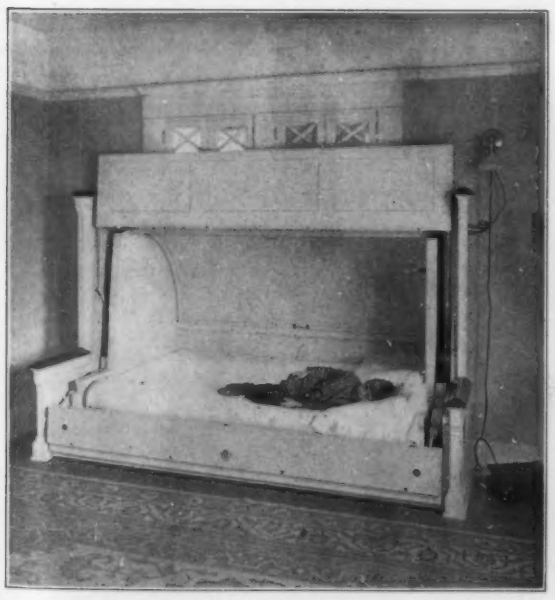
Diamonds produced in the electric furnace.

Hints in Varnish Making

TRANSPARENT varnishes or lacquers are readily made by dissolving gum copal or gum dammar in the proper solvents. However, it is not generally known that the solubility of gum copal in alcohol is greatly increased by first melting the gum. It loses about twenty per cent water by this treatment and changes its properties. In fact, it becomes much more soluble in turpentine. It should be melted at as low a temperature as possible or black specks will appear.

A Bed in the Open for City Dwellers

SLEEPING outdoors is one of the luxuries of camp life that is becoming popular among dwellers in the city. Heretofore, only those who had ample house room for a sleeping porch could enjoy the fresh air and sound rest that goes with an outdoor bedroom, but a western inventor has solved the problem for the benefit of those with limited space; even apartment house dwellers can now enjoy a night in the open without leaving the flat. The bed is built upon a balcony that projects only a couple of feet beyond the wall of the house. It is protected by a railing and an insect-proof screen. By day the bed is covered by a dome of metal that protects it from the weather, and at night, when the couch is in use, the occupant shifts the dome to the inner side of the bed, so that the outer side is uncovered. In case of a rain coming on during the night, he can swing the dome back to its original position without getting up. For protection against light showers, heavy dew and morning light, a waterproof curtain is provided, that is drawn down to any distance, following the curved line of the screen. This also secures privacy in the morning. For the convenience of nocturnal readers, a bulb is placed over the head of the bed. For making up the couch, the whole body can be drawn into the room, and as readily rolled back into place. Then a few hinged parts are unfolded, and an attractive "built in" divan occupies the place where the bed is concealed. This provides the advantage of the ordinary folding or disappearing bed by adding a living room, for use by day, to a small apartment. The device is installed in various private homes and apartments on the Pacific Coast.

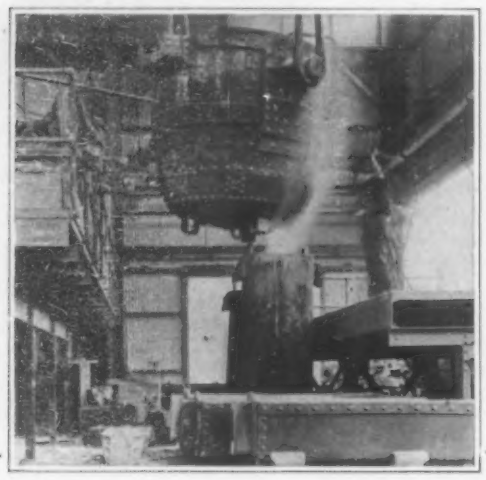


By swinging up the dome at the back into the room the bed is opened to the outer air.

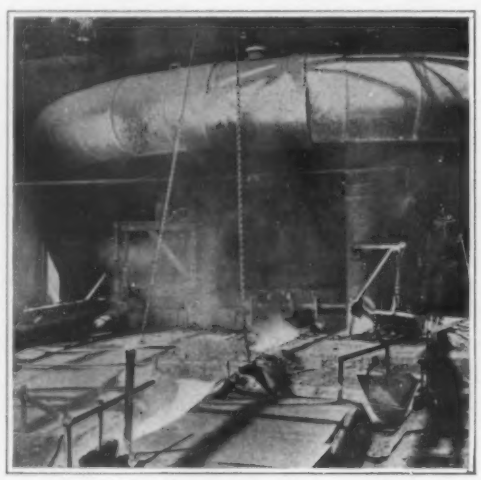
The bed is built upon a shallow balcony.

By unfolding a few hinged parts the bed may be converted into a divan.

A bed in the open for city dwellers.



Pouring electrically refined metal into the ingot mold.



Tapping the metal from the base of a blast furnace.

Charging a Bessemer converter with hot pig.

Safety in Travel as Affected by the Steel Rail

The Problem of Producing a Rail Which Will Stand Up Under Heavy Modern Traffic

So far as the mechanical or material side of the problem is concerned, there is no single element upon which the safety of railroad travel depends so greatly as it does upon the steel rail. Also it is certain that there is no single element which is subjected to such brutal treatment in its daily service, or that is called upon to endure such varied and destructive stresses as this important member. Furthermore, it is certain that the work imposed upon the rail has at least doubled during the past two decades. Not only must it serve as a true plane surface to receive heavy and swiftly moving loads, but it must act as a continuous bridge, carrying these loads from tie to tie, and often, because of inequalities of the roadbed, supporting the same loads over distances measured between several ties. The steel rail is subjected to severe compression in the height of the summer weather, and equally severe tension during the cold of winter; it is exposed to bending, twisting, and shearing stresses in every conceivable direction and of constantly varying amounts, and these stresses frequently occur with rapid reversions. Finally, it is subjected to hammering blows from poorly balanced locomotives, which alone call for a very high quality of material.

In the early days of railroading, when speeds were lower and weights upon individual wheels were not one half what they are to-day, it was possible to use a tough and ductile rail which possessed sufficient hardness to stand long service without being crushed by the traffic. Of late years, however, the weights of engines and cars have gone up by leaps and bounds, and contemporaneously with this increase has been a great increment in the average speed, both of passenger and freight trains. The earlier and comparatively soft rails failed to stand up under these loads, and the composition was changed so as to include a larger percentage of carbon, giving a corresponding increase in the hardness. With this advantage came the disadvantage of increased brittleness, and while the high-carbon rail no longer battered down under the heavier traffic, it became more subject to breakage.

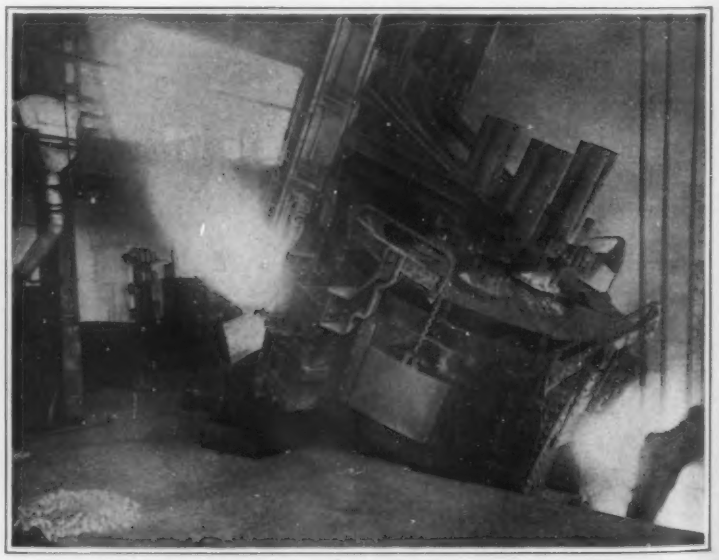
Rail head split by the cold-rolling and wedging action of heavy concentrated wheel loads.

It is the purpose of the present article to give a condensed sketch of the present methods of rail manufacture as generally followed in this country, and to point out the lines along which improvement is being sought and, in some cases, realized.

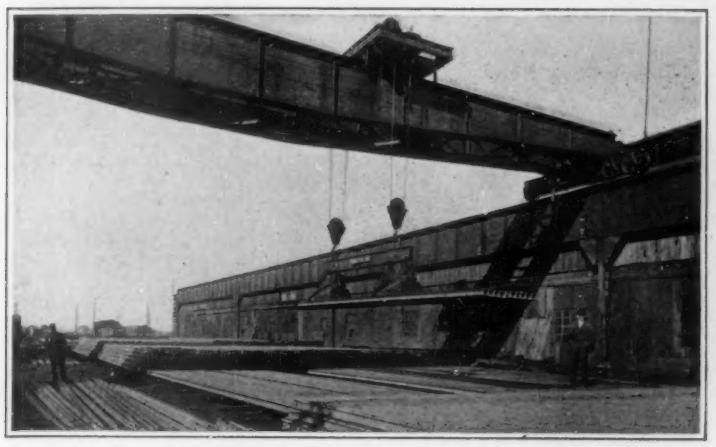
In the manufacture of the steel from which rails are rolled there are two principal processes; first, the reduction of the ore in the blast furnace; second, the conversion of the molten iron into steel, either in the Bessemer converter or in the open hearth furnace. The raw materials of manufacture consist of iron ore, coke and limestone in proportion of two pounds of ore to one pound of coke and one third of a pound of limestone. The ore is reduced in the blast furnace, a huge steel shell, brick-lined, which varies from 75 to 90 feet in height. The materials are loaded into bins back of the blast furnaces, from which they are drawn off into skip hoists, and by them carried to the top of the furnace. Here the contents are discharged into a cone-shaped hopper, from which they descend into a second hopper immediately below it, with space between forming a chamber on the principle of the air lock. By this arrangement the escape of gases from the furnace is prevented. When the lower hopper is opened by lowering its cone, the materials fall evenly over the top of a charge already in the furnace. From the top of the furnace the gases are conducted by a large steel pipe to a set of four or five hot-blast stoves filled with fire brick, where they are ignited and serve to raise the brick to a high temperature. The air blast for the blast furnace is passed through the heated stoves, and the air, as thus heated to a temperature of 1,000 to 1,400 deg. Fahr., is conducted through tuyeres into the bottom of the blast furnace. About one third of the gas produced is required to heat the stoves and the remaining two thirds is used either as fuel under the boilers to generate steam, or, as in the case of the Gary Steel Works, used directly in large gas engines. At the Gary works the power so generated is used in the rail mills, merchant mills, bridge works and mills for rolling steel sheets.

When once a blast furnace has been started, it is maintained day and night in continuous operation. The temperature ranges from about 500 deg. Fahr. at the top of the furnace to 2,600 or 2,800 degrees at the base. The molten iron and slag collect at the bottom of the furnace, from which they are cast into ladles mounted upon trucks, each of the ladles being capable of holding as much as 50 tons of hot metal. The ladles are drawn in trains of five or six to the mixers—large iron receptacles capable of holding from 400 to 600 tons of

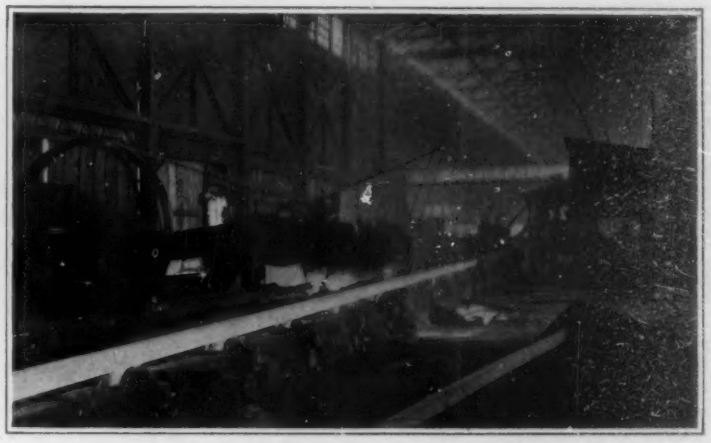
Pouring a heat of steel from a Bessemer converter into the ladle.



Electric furnace tipped over and discharging into the pouring ladle.



Eleven rails lifted at once by the electro-magnetic crane.



The hot saw cutting the finished rail into rail lengths.

molten metal—from which it is discharged as required into trains of ladles and taken either to the Bessemer converters or to the open hearth furnaces.

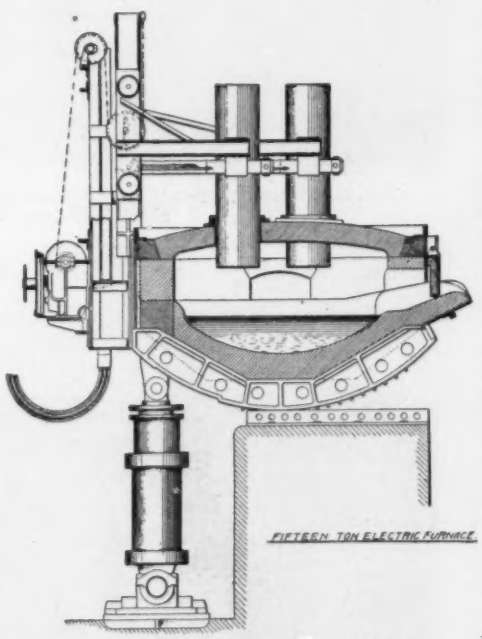
Up to this point the product is simple, molten cast iron, which, if run into molds, would form the common cast pig iron of commerce. From this point on, the process is one of converting the cast iron into steel of the required composition and quality.

Hitherto, steel for rails has been known either as Bessemer or open hearth, these two being the main processes employed in the production of steel in such large quantities as are required for steel rails. During the past few years, however, thanks to the enterprise of the United States Steel Corporation, it has become possible to produce rail steel in commercial quantities by the use of the electric furnace—a subject to which fuller reference will be made later in the present article.

The famous Bessemer converter is a barrel-shaped, wrought iron or steel vessel, lined with refractory materials, and carried on trunnions, through which an air blast is conveyed to the bottom of the converter, which it enters through some two hundred separate half-inch air holes. The converter is swung over in the direction of the ladles of hot metal and charged with about fifteen tons. The air blast is turned on, and it is then swung into the vertical position. As the air rushes up through the molten mass, the oxygen combines with the carbon, silicon, manganese, etc., in the iron, raising the temperature to about 3,100 deg. Fahr. or 700 to 800 degrees higher than at the beginning of the blow. In eight or ten minutes time all the impurities and practically all of the carbon have been burned out, leaving only nearly pure iron. As pure iron is a comparatively soft metal, so soft in fact that it may be cut with a pocket knife, it is necessary to combine with it elements that will produce the requisite degree of hardness to resist the crushing and abrasive action to which the rail is subjected. The most available substances for the purpose are carbon and manganese, about one half of one per cent of the former and one per cent of the latter, being the proportions generally employed.

The converter is then swung over on its trunnions and its charge is emptied into a fifteen-ton ladle, and at the same time a certain amount of molten spiegeleisen is poured into the ladle with the iron, the proportion being such as to introduce into the metal the proper amount of carbon and manganese for the quality of steel rail that is to be made. The hot metal is then drawn off from the bottom of the ladle into a series of rectangular cast iron ingot molds, measuring about 22 inches square in section and about six feet in average height.

In the open hearth method the metal from the mixers is poured into large closed furnaces, each furnace in the later and most modern plant containing as much as ninety tons. A certain amount of steel scrap iron ore and limestone is added. The charge is then subjected to the fierce heat of burning gases, which enter at one end of the furnace, pass over the charge and leave through flues at the other end. From time to time samples are taken from the furnace and tested. The ultimate object of this treatment is the same as that of the air blast in the Bessemer converter, and although the operation consumes much more time, it possesses the advantage that, by means of it, certain grades of metal not suitable for making Bessemer steel can be utilized. The impurities are oxidized out of the metal and the various alloy additions are made until the proper percentage of carbon, manganese, etc., for the particular grade of steel that is being made has been reached. The metal is then ready for pouring into the ingot molds.



Section through a fifteen-ton electric furnace.

The process of rail making as thus far described applies broadly to any large rail-making mill. The description that follows is based upon a visit recently paid to the works of the Maryland Steel Company and applies particularly to the methods followed at that plant, the rails from whose mills have shown particularly good results during the past few years. The excellence of the product is due largely to the good quality of the Mayari ores, which come from the company's mines in Cuba. These ores contain nickel and chromium and are unusually low in the deleterious phosphorus. In addition to possessing excellent ore, the company at this works pays particular attention to the ingot treatment.

At the Sparrow's Point mills special effort is made to reduce segregation, that is, the tendency of the constituents of the steel to separate out during the cooling of the metal in the ingot mold and form certain centers in which these separated constituents are concentrated. Nothing, not even the pipe itself, is considered more pernicious in destroying the quality of a steel rail than segregation. To prevent or reduce segregation the metal is poured into the mold at as low a temperature as practicable in order to facilitate early solidification, and the ingots are placed in the soaking pits as soon as possible after they have been cast, in order to conserve their heat as well as to produce a better surface on the rail. In the soaking pits, the temperature of the ingot is equalized, and it is then taken out and given thirteen passes through a thirty-six inch blooming mill, in which it is reduced to eight by eight inches in section. Nine per cent of the original ingot is cropped off to remove the pipe and segregated material, and the blooms then go to a 27-inch rail mill, where it makes six passes in the first, four in the intermediate and one pass through the finishing rolls. In the finishing rolls, the brand mark is rolled into the rail, as is also the number indicating the position of that rail in the original ingot. The rails are then run on to the hot bed and allowed to cool. From the hot bed they go to the straightening press; after which all burrs and irregularities are chipped off and the splice-bar holes are drilled in the ends. It should be explained here that the rails are cut to length by high-speed circular saws, and that they are cut sufficiently longer than their

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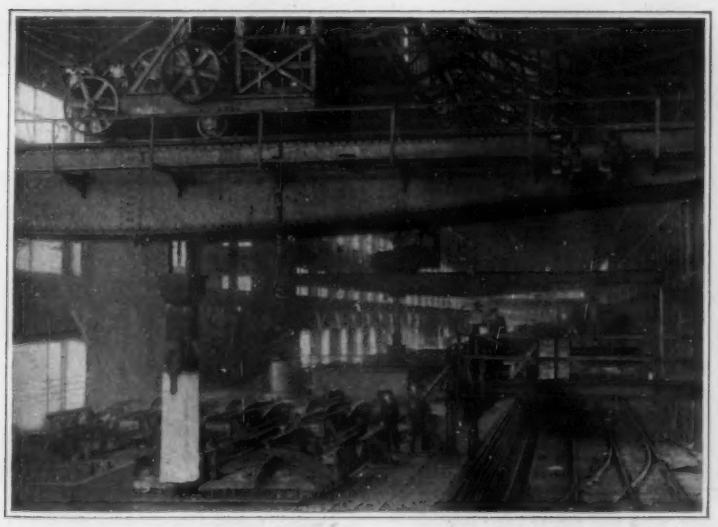
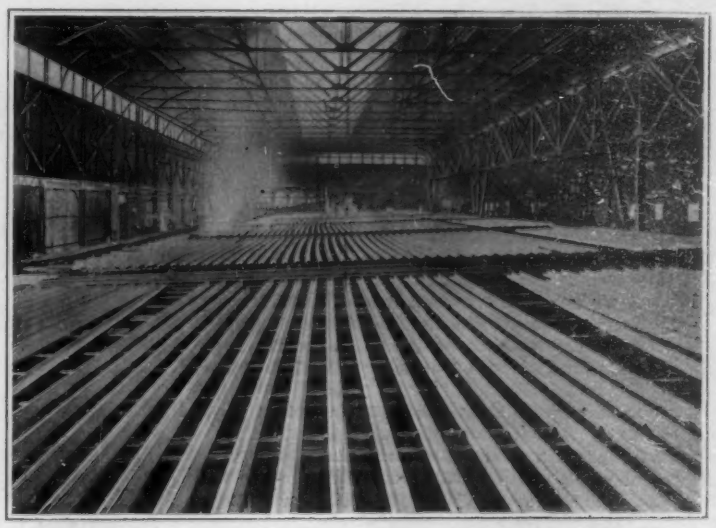


Electric crane handling an ingot above the soaking pits.



The hot bed on which the finished rails are left to cool.

The Problem of the Small Farm Tractor

Agricultural, Mechanical, and Economical Factors that Must be Considered

By Lynn W. Ellis

THE horse is by far the most flexible motor for small jobs. The tractor cannot compete with him in much of the necessary work of the farm. The weight and cost of materials for a given horse-power decrease as the machine grows in size. The unit cost of labor in producing the small machine is higher, and the cost of operating also. The cost of distribution per unit of power will possibly be offset through the greater number of possible buyers.

As yet the small farmer cannot supplant all his horses with a small tractor. The man with sixteen horses worth $2,000 to $2,400 as a minimum can keep four for light work and, with the proceeds from the sale of the others, buy a tractor that will do the work of the original sixteen. The small farmer must keep a larger percentage of his original number, and must now actually increase his investment with the purchase of a small tractor.

The proportion of power delivered to the plow by a machine necessarily decreases as the weight per horse-power is increased, leaving less and less power for plowing as the machine grows smaller. The width of a machine cannot be decreased as fast as its power. Both these factors and the absolute necessity of keeping the tractor from traveling over ground that has previously been plowed, concentrate the weight at one side instead of the center. The resulting side draft lessens the durability and increases the difficulty of steering the machine. Moreover, the tractor that does not plow out its own width is charged with additional compression of the soil through increasing the number of trips over the field in proportion to the total number of furrows. The one-mule plow puts the power directly ahead of the load. The four horses abreast gang-plow necessitates the use of an equalizer—a vexatious problem with the farmer who would like to overcome a natural, but inexorable, law of mechanics.

It seems then that the small tractor faces serious problems, the nature of which may explain the slowness with which an apparently overwhelming demand is being met by the manufacturers, who naturally would be the first to profit. Not over twenty-five small tractors are now being advertised, but there are literally hundreds of small tractors of various styles in existence, with many departures from the standard type of tractor, that has proved so successful in the larger sizes. Those that will be touched upon are only a few of the great number that will illustrate the ingenuity that is being displayed in the attempt to solve this problem.

A Small Chinese Copy of the Big Tractor Will Not Do.

Probably the greatest number of small tractors are built in the attempt to reproduce the large or medium-sized machine on a smaller scale, not sacrificing any of the versatility of the ordinary tractor in an attempt to solve the peculiar difficulties of the small one. It seems quite feasible to make a tractor weighing approximately 10,000 pounds, developing ten or twelve horse-power at the drawbar and twenty to twenty-five horse-power for belt-driving purposes. Several of the larger tractor builders have accomplished this without difficulty. Not one, however, has as yet developed a commercial success equal to what has been achieved with the next larger size, having the power of about fifteen horses in draft and thirty horse-power at the belt pulley.

The small tractors that follow the general lines of the larger ones, range in weight from about 4,000 to 8,000 pounds. The greater number attain this lightness at a sacrifice of simplicity, that is, by the use of two-cylinder or four-cylinder motors. The motors are usually of the automobile type, running at 500, 800, or even 1,000 revolutions per minute. They are, therefore, naturally flexible as to speed, and even at the expense of additional cost they are nearly all equipped with two or three changes in gear speeds. They are made for traveling at approximately 1½, 2½ and 3½ miles per hour, varying of course with individual designs. These speeds represent a high speed for hauling light loads or returning with empty wagons; a medium speed for hauling loads and plowing; and a slow speed for getting out of difficulties, climbing hills, or moving heavy loads for moderate distances. The high speeds are used for harvesting, drilling, harrowing, and other work not requiring much draft. Tractors of this size usually handle two plows easily, and three under favorable circumstances. Naturally, the plowman is dispensed with and one man runs both tractor and plows.

An interesting mechanical difficulty is met in the operation of plowing with a tractor of this type. A large tractor, with a gang of six to a dozen plows, has sufficient power to break off a single plow, in case it meets a solid obstruction. When the small plow strikes a stump or stone, the light tractor is checked, and some designers have felt it necessary to provide a friction

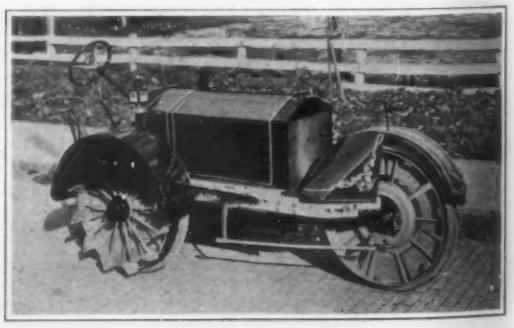
One of the many "general purpose" tractors that will haul loads to market or draw farming implements.

Steel hoof tractor preparing the ground, hauling drag and roller, and sowing seed. The machine weighs about 5,000 pounds and develops twenty-two horse-power.

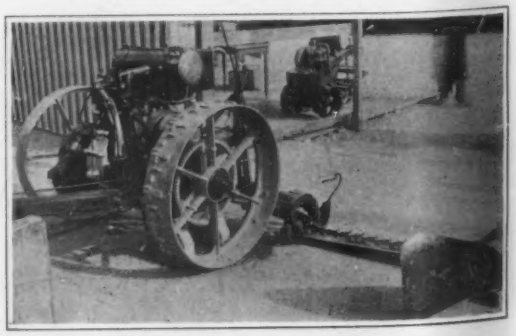
Another of the many small tractors with special drive wheels.

Self-contained traction plow, with one power lift plow slung underneath the tractor frame.

A machine especially designed for orchard cultivation. The engine is rated at twenty to twenty-five horse-power. The tractor is here shown dragging.

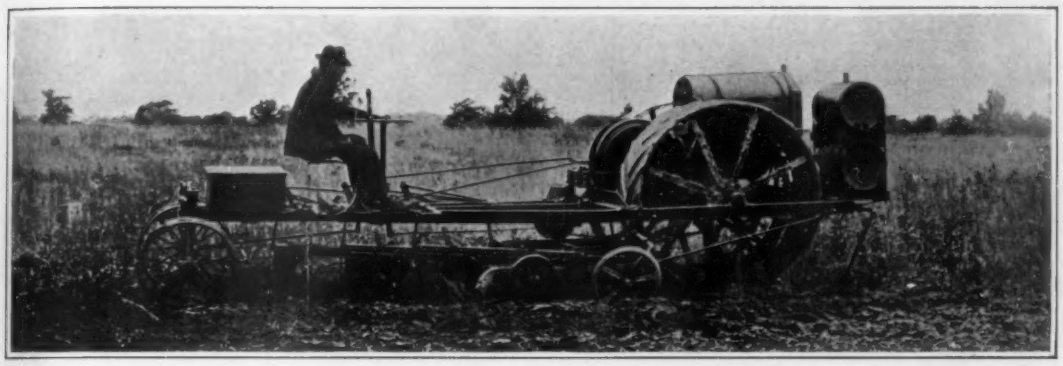


Three-wheel gasoline orchard tractor. Plowing speed, two miles per hour; hauling speed, six miles.



A French automobile mowing machine. In the background an auto-cultivator.

A light-weight tractor with a two-cylinder eighteen brake horse-power engine.

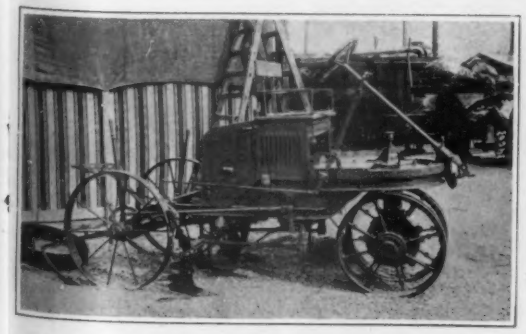


View of a four-cylinder front-drive tractor with a series of under-mounted plows, at work on an ordinary sized farm.

A motor plow and cultivator that will straddle a row of corn or go between two rows. A five horse-power motor runs it as fast as a man cares to walk all day.

A two-cylinder nine horse-power motor propels this little plow.

A light-weight California tractor with special hoof-like wheels for use on soft ground.



A French auto-cultivator for intertilled crops. Cultivator shovels are underneath the frame.

The wake of a California orchard tractor. Note how closely it runs between the rows.

contact at some point in the transmission, so as to allow a sudden stop without serious damage to the driving mechanism.

How Wide Should the Tractor Be?

One difficulty that has already been mentioned is the matter of width, and considerable thought has been given in the matter of reducing this as much as possible. In one small tractor this has been reduced until there is a width of but sixteen inches between the drive wheels, each of which is twenty inches in width. The weight of the machine—a single-cylinder—is but 6,000 pounds. Nearly three fourths of this is supported upon the drivers, and since the bearing surface is so large, the weight per square inch upon the ground is far below that of the average horse's hoof. A pressed-steel frame, which serves also as a gear-case, is one of the features of this machine, making for strength, lightness and compactness. The gears are all of steel, machine-cut, and the machine-shop equipment of the small farmer has been kept in mind, with the result that the heaviest piece on the entire machine weighs but 300 pounds and can be put in place by two men.

An interesting variation from the ordinary type is a tractor with four drive wheels. The use of four traction wheels is claimed to reduce the weight that is necessary, because the number of points of contact is increased and the concentration of weight necessary for traction at one point is avoided. Several builders of small tractors have sought to lessen the side draft by running one drive wheel in the furrow, either allowing the machine to operate with the axle out of the horizontal, or else providing an adjustment whereby the right-hand driver may be dropped downward without unmeshing the gears. One tractor uses the front right-hand wheel as a steering guide by facing it on the inner side, next the furrow wall, with a circle of sheet steel.

The Orchard Tractor.

Small tractors for orchard work are being developed with surprising rapidity. The success of the commercial orchardist on the Pacific Coast has been due largely to cultivation, and the man in the East is also learning to keep the ground under the trees stirred continuously throughout the season. This calls for a low-down, light, short-turning tractor. At least a half dozen which embody these essentials have been offered the public in the last two years.

The most widely distributed one to date weighs 8,200 pounds without extension rims or the shields which are sometimes put on for cultivating in orange orchards. A peculiar, basically-patented feature of this machine, which has been somewhat closely imitated, is the arrangement of the cleats on the drive wheels, so that they enter the ground in the same direction as the horse's toe. The pressure upon the soil is backward instead of straight down, as in the ordinary solid wheel tractor. The ground is left ridged in the path of the machine, instead of in a depressed layer, and is thus more easily crumbled by the cultivating tool. Even where the path of the tractor is not effaced immediately afterward, the loose soil tends to fill up the depressions and thus to establish a protective mulch.

One similar tractor has a combination of rubber tire and these peculiar cleats, to adapt it for rapid travel on the roads. Nearly all of the orchard tractors are of three-wheel type to allow of shorter turning. As might be supposed, the horizontal cylinder is used more frequently than the vertical in order to keep down the height. Successful orchard tractors have been developed that stand less than five feet high, even with limb shields. They are able to go close to trees and handle plows or cultivators without injury to the limbs.

One orchard tractor is provided with a large steel hood, which can be set on or off easily, and which, when in place, leaves no sharp angles or projections to damage trees or fruit. When the hood is not needed it can be taken off and a cab substituted. An extra set of wheels, lower than ordinary, is provided in order to change the regular type of tractor into the orchard type.

The admitted difficulty of plowing close to the corners in fenced fields with a tractor and trailing plows, has led many inventors to design machines in which the plows could be raised clear of the ground and the machine backed up into the corner. One quite well-known auto-plow handles three plows, directly underneath the frame. The drive wheels are in front, the rear wheel being used for steering. The plows are lifted and dropped by a power-device. The outfit is handled about like an automobile, and almost as easily.

Another illustration shows a single-plow tractor with the plow underneath the frame, and close to the right-hand side. One front wheel runs in the furrow to assist in steering. The driver sits in front and the plow is handled entirely by power. The same maker hitches the plows immediately behind in using two bottoms. In this case the driver sits in the rear. The tractor with

(Concluded on page 525.)

A Safety Parachute for Airmen

ALEO STEVENS of New York city has invented a novel compact safety aeroplane parachute. F. R. Law and Arthur Lapham with its aid have made all told a score of leaps into space from bridges, buildings, speeding aeroplanes, exploding balloons and the like without mishap.

As shown in our illustration, the parachute is rolled up into a pack worn on the aviator's shoulders like a knapsack. It is wrapped in a square piece of cloth which, when the parachute opens, remains with the harness of leather straps by which the aviator is supported. Instead of the harness which was used by Law, a leather belt is all that is necessary.

When made of Japanese silk this new safety parachute weighs only 4½ pounds complete. It is 16 feet in diameter and is attached by 16 Italian hemp ropes to a spreader bar of steel tubing filled with hickory, which is located 15 feet below the parachute when open. A wire rope having a breaking strength of 1½ tons is secured to the spreader and the supporting ropes are fastened to the strong cable. Two additional ropes two feet shorter than the main ones run to the 12-inch hole in the center. These ropes receive the initial strain when a drop is made, assure the proper opening of the parachute, and put an equal strain upon the top by drawing down upon it. The rush of air against the folds, however, is what really opens the parachute. So sensitive is it to this, that it is designed to open within 100 feet. The jumper also holds in his hand a small cord, by pulling which he opens the parachute in case he has only a short distance to fall.

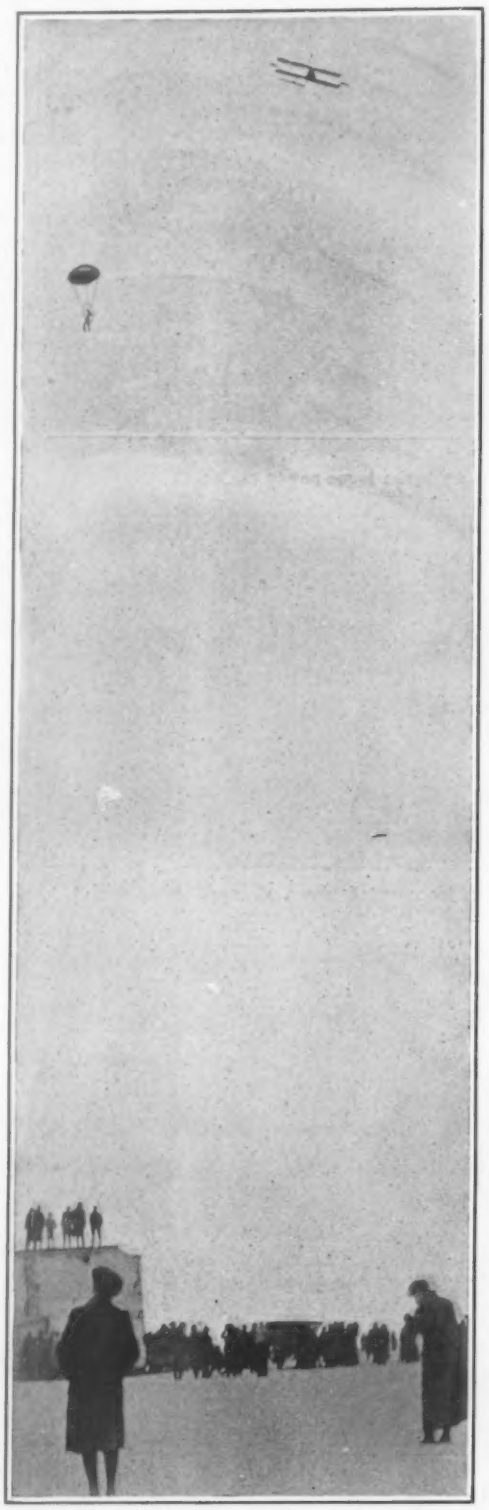
On the sensations of the aviator when his machine is suddenly relieved of 150 pounds weight, Mr. Harry B. Brown has this to say:

"When I reached an elevation of 4,000 feet, I motioned to Law to prepare to give me a return motion of the hand, indicating that he was ready to go. I nodded my head and away he went. I saw no more of him until I reached the starting point some eight minutes later, when I was notified that he reached the earth 2¼ minutes after making the jump. As he released his weight from the moving machine, I felt myself go up rapidly and the machine acted very much as if it were suspended by a cable and was being pulled up rapidly by jerks. This lasted for perhaps ten seconds. The machine all this time was on an even keel."

That such parachutes are not an absolute provision against accidents which may prove fatal, is shown by the harrowing experience of Arthur Lapham on May 30th at the Aeronautical Society's flying carnival, held at Oakwood Heights, Staten Island. With the Stevens pack upon his back, Lapham was to drop a mile from a Wright biplane, piloted by H. B. Brown. At a height of a few hundred feet—three hundred, according to some spectators—instead of the promised mile, Lapham slid from his seat and shot down. The parachute did not open, probably because the drop was too short. Fortunately for Lapham, he landed without injury on the marshy salt meadow flats near Prince's Bay. He was buried up to his armpits in mud and had to be dug out.

Over $100,000 in Prize Money for a Safe Aeroplane

ACCORDING to *La Nature*, the Union for Safety in Aeroplanes of Paris is to hold a contest in order to recompense the inventors of apparatus which will bring an important contribution to the security of heavier-than-air machines. The funds for prizes have all been subscribed, the sum actually raised being 582,000 francs ($116,400). A main prize of 400,000 francs ($80,000) will be given the inventor of a machine or device that, in the estimation of the judges, has an exceptional interest from the point of view of safety. This *grand prix* will not be divided. In addition to it, other prizes aggregating not less than $4,000 more will be given to other inventors of important devices. The judges consist of fifteen members, ten of whom are named by the Union, one by the Minister of Public Works, one by the Minister of Marine, and three by the Minister of War. It is to be hoped that the large sum subscribed will be the means of stimulating the solving of the problem of safety in aeroplanes.



First parachute drop ever made from an aeroplane.

Capt. Berry dropping from Antony Jannus' **Benoist** biplane at St. Louis, Mo.

Lapham ready to jump with the Stevens pack on his back.

Harry Brown and F. R. Law in a Wright, showing the latter's safety pack in place.

Lapham just after jumping. The parachute opens in a few seconds.

Red Light as a Preservative of Milk

INTERESTING experiments have recently been made concerning the influence of red light on milk. That light as such is detrimental to the conservation of milk has long been known, but which of the rays really did the mischief has only now been determined, when it was found that the red rays are beneficial, while those toward the violet side of the spectrum caused the milk to "turn." Pure, fresh milk placed in an uncolored glass bottle in the full sunlight, and sterilized and pasteurized milk, placed also in uncolored bottles in the same place were found at the end of the day to be completely spoiled and unfit for consumption.

Absolutely no difference could be detected between the ordinary "fresh" milk and that which had been sterilized—both were equally bad. But if even unsterilized milk is placed in a red bottle or in a bottle wrapped in red paper in the full sunlight it keeps perfectly good for ten hours. In Holland much care is being expended on delivering pure milk to the public. The "fresh milk" is brought around by the milkmen in large, covered, brass vessels placed on small handcarts. On these same hand-carts are open holders to contain the bottles of pasteurized or sterilized milk, which costs rather more, but to which many people give the preference, as it is considered more hygienic. Now, however, that experiments have proved how easily even this pure, sterilized product "turns" by the influence of the light, it may soon be expected that every dairy will adopt red bottles. Until a sufficient quantity of such shall have been manufactured, the bottles will be wrapped in red paper.

The Electrical Stimulation of Plant Growth

THE question of increasing the growth of plants by applying electricity in various ways is one which is being discussed at present. One of the principal workers in this direction in France is Lieut. Basty, and he is now engaged in making some very interesting experiments upon the growth of crops. The excellent results which he obtained have attracted the attention of the Agriculture Department, and the minister is now having the matter taken up from a scientific standpoint. Lieut. Basty is now proceeding in his experiments, upon the basis that the atmosphere is an inexhaustible source of electricity, and on the other hand physiologists assert that the electrical effect serves to hasten and also regularize the circulation of liquids in the capillary tubes, such as those of plants. If we cause electricity to act on the stalks or roots of a plant, the circulation of sap is stimulated and made more regular, so that the growth of the plant is more rapid and the assimilation better carried out, hence the production from the plant will be more abundant. This idea seems to be borne out by an actual increase in the amount of crops which the author finds. He collects atmospheric electricity by small lightning rods which consist of simple iron rods ending in a non-rusting point. For vegetable gardens, the rods should be about 3 feet high, but for field crops such as wheat and other cereals, hemp and the like, the rods should have 6 feet height. The diameters are from ⅛ to ¼ inch, and the rods are driven in the ground for 8 or 10 inches, according to the length of the roots of the plants. It is found that the action is exerted on a radius on the surface of the ground equal to the height of the rod. In practice, the cost of such rods and the labor in mounting them is very small. The following figures for the increase in the growth of certain crops may seem surprising, but they are given on good authority. For potatoes, instead of 100 pounds as before, he now obtains 173 pounds. Beets show 166 pounds. Hemp, for the stalk, 328 pounds, against 100 pounds in all these cases.

The Ten Greatest Inventions of Our Time

We hear much of the great inventions of the past—the telegraph, the sewing machine, the telephone, the reaping machine, photography, Bessemer and open hearth steel, the steam engine and the phonograph. Yet the inventions of our own time are as epoch-making and as dramatic as these.

Perhaps because we have become accustomed to the use of the old machines and discoveries, perhaps because the achievements of latter-day inventors succeed one another so rapidly that we are not given much time to marvel at any one of them, we have not fully realized how stirring and wonderful are the products of modern ingenuity.

Only five years ago the man-carrying aeroplane made its first public flights; only the other day hundreds of passengers on a sinking ship were saved with the aid of wireless telegraphy. At least a dozen inventions as great have been perfected in our own time, and all of them have made a man's work count for more than it ever did before, and have made the world more livable than it ever was.

Why should we not tell the story of our own deeds?

Why should we not pass in review the new industries created by men who are still living, men whose names will go down into history with those of Watt, Morse, McCormick and Howe?

That was the underlying idea of the November Magazine Number of the Scientific American. We knew that the "ten greatest inventions of our time" was a big subject when first we planned the number, but how big it was we never realized until we surveyed the field of modern invention.

Then we saw how astonishing was the progress made in our own day, how much mankind had benefited by the inventions of great modern intellects. We began to appraise inventions, to weigh one against the other, and to determine in our own minds which ten had contributed most to human progress and happiness, which were really great pioneer inventions, and which merely remarkable and valuable improvements on successful past conceptions. There were so many achievements to consider that it was hard to arrive at a definite conclusion.

The upshot of our own thinking has been to leave to our readers the decision

What Are the Ten Greatest Inventions of Our Time, and Why?

For the Three best articles on the subject, we offer in the order of merit, Three cash prizes:

First Prize: $150.00 for the best article
Second Prize: $100.00 for the second best article
Third Prize: $50.00 for the third best article

On another page in this issue will be found the rules that will govern the contest.

Notes for Inventors

A Device for Preventing Rail Spreading.—Percival H. Truman, of Evanston, Ill., assignor to Laas & Sponenburg Company, has secured a patent, No. 1,060,037, for a construction to be applied to a railroad rail. It has a flat vertical surface against which the base of a rail may abut at different heights, a projection at the upper end of the vertical surface to bear against the vertical web of the rail under the tread, and an oppositely projecting base portion which in practice is spiked to a tie.

A Leak Stopper for Boats.—Herman Flugeltaub, of Minneapolis, Minn., assignor of one half to William Weisman of the same place, has patented a device for stopping leaks in boats which includes a housing applicable to the outer face of the hull of a boat to stop the leak and adjustable to cover more or less of the surface of said hull. The housing is expansible and contractible in securing the telescopic adjustment desired. The patent is No. 1,060,177.

A Number of Train-signaling Patents.—Andrew J. Allard, of Richmond, Va., assignor of one third to T. F. Green and one third to David R. Creecy, Jr., both of Richmond, has secured patents, Nos. 1,060,398, 1,060,400, 1,060,401, 1,060,402, 1,060,403, 1,060,405, for electric signaling and controlling means, also patent No. 1,060,399, for electric train-controlling means; No. 1,060,404 for train-controlling means, and Nos. 1,060,407 and 1,060,408 for electrical block-signaling systems.

A Novelty in Baseball Gloves.—Charles M. King of Washington, D. C., assignor to A. G. Spalding and Bros., has patented a baseball glove and mitt, No. 1,056,909, which has a flexible palm and a back portion and suitable padding, and the palm portion is provided with a plurality of perforations and a reinforcing layer of flexible material is secured upon the back of the palm portion.

Utilizing Worn-out Car Wheels.—Edwin E. Slick, of Pittsburgh, has secured patent No. 1,055,672 for a method of utilizing worn-out car wheels in which the wheel is heated and the web is thinned by rolling and forcing the displaced metal radially outward into the tread and flanged to reshape the flange and tread and simultaneously increase the diameter of the wheel.

Another Non-refillable Bottle.—In a patent, No. 1,055,595, to Herbert C. Atkins, New York city, assignor of one third to Edwin Dumble and John Wegmann each, is shown a non-refillable bottle comprising a white glass vessel and a piece of material sensitive to white light and secured to the vessel so that it will be protected by the contents of the article from the white light. Such strip will be affected by the light passing through the vessel but will not be affected by the light passing through the contents of the vessel, and the strip is so located that it will be protected on one side by the contents of the vessel and on the other side by the label.

A Collapsible Fire Extinguisher.—In patent, No. 1,057,538, John R. Gammeter of Akron, O., shows a fire extinguisher in which there is a collapsible tube similar to an ordinary paint tube and filled with a fire extinguishing agent. It has a nozzle at one end, while at its other end it has a hand roller of large diameter upon which the tube may be wound up and collapsed to put pressure upon the contents and to squirt them from the nozzle.

A Novel Food-product Package.—An unpreserved food product which would be injuriously contaminated by contact with the air is encased over its entire surface with a covering of tinfoil coated with paraffin on the inside next to the food and forms the subject of patent, No. 1,057,552, to Alexander J. Howell of Syracuse, N. Y. The original application for the patent was filed January 3rd, 1905.

Butter Packages in the Far East.—In the far East, India, for instance, it is reported that butter when shipped in tins and the tin is opened, the butter deteriorates rapidly, and it has been suggested that butter might be packed in collapsible tubes of tin with screw nozzles similar to those in which printing ink, oil paints and some

INQUIRIES

Inquiry No. 9312. Wanted to buy a machine which will pick up a weight the size of a lima bean by vacuum process. Must be able to pick up dust, gravel, etc. Must be operated by electricity and be easily portable.

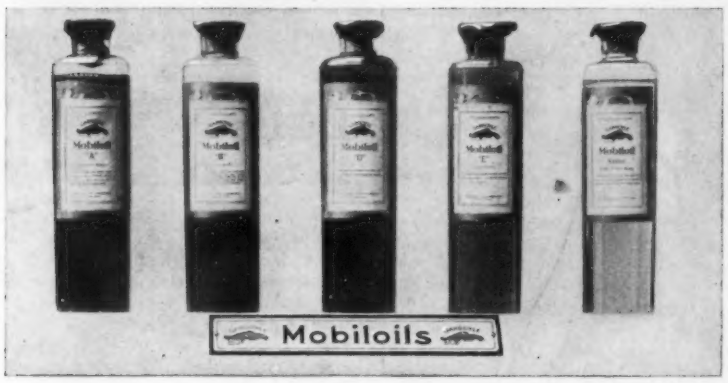
Inquiry No. 9313. Wanted to buy Leather Held Horse Shoes used temporarily when shoe cannot be nailed on. In other words a Leather Boot with iron shoe at bottom—strapped over horse's foot.

Inquiry No. 9314. This enquirer is in the market for some patented articles which he could purchase and manufacture with an investment of from $5,000 to $10,000. The name of the party will be supplied to any of our readers on application.

Inquiry No. 9315. Wanted the name and address of a concern manufacturing novelty ink wells.

Why several grades?

Here are five 4-ounce bottles. Each is filled with a different grade of Gargoyle Mobiloil.



The grades all differ in thickness, or "body."

These oils meet the most severe tests that have ever been exacted from automobile lubricating oils. In sheer lubricating quality they stand alone.

But that, of itself, is not sufficient.

To properly reach the many friction points the oil's "body" must be suited to your feed system.

To make this condition plainer, a homely illustration may be taken from the sewing room:

A fine thread is often too light for the wear required. A heavy thread is often too thick to pass through the eye of the needle.

Neither meets requirements.

So it is with automobile lubricating oil.

Quality equal, the heaviest-bodied oil will prove the most durable. But to be of service it must be able to properly pass through your lubricating system.

The conditions to be met are complex. The problem is serious.

Motors differ.

Feed systems differ.

Before the oil which best combines durability with ability to meet the feed requirements of your car can be determined, the construction of your motor must be known and carefully considered.

We have undertaken this problem with the thoroughness that has established our standing in the general lubricating field.

Every year we analyze the motor-construction of each of the season's models. Guided by this analysis and by practical experience we determine the correct grade of Gargoyle Mobiloil for each make of car.

Our findings we list in a lubricating chart, printed in part on this page.

The oil specified for your car in this chart is the scientifically-correct grade for your motor.

The superior efficiency of these oils has been thoroughly proven by practical tests.

If you use oil of lower lubricating ***quality,*** *or of less-correct* ***"body"*** *than that specified for your car, loss of power, unnecessary friction, and ultimate serious damage must result.*

A word about ourselves.

Lubrication with us is both a business and a profession.

Throughout the world the lubricating counsel of the Vacuum Oil Company is sought by engineers who must meet the most rigid efficiency standards.

Our clientele includes thousands of manufacturing plants —located in practically every civilized country.

We supply the floating armaments of the world's leading naval powers.

We supply the aeroplane fleets of the leading military powers.

Outside of the home field we supply over seventy foreign automobile manufacturers.

The lubricating chart on this page represents our professional advice.

We suggest that you note down the grade specified for your car.

In buying Gargoyle Mobiloil from dealers it is safest to order either a full barrel, half-barrel or a **sealed** five-gallon or one-gallon can.

Make certain that you see the name and our red Gargoyle on the container.

A booklet, containing our complete lubricating chart, together with points on lubrication, will be mailed you on request.

The various grades, refined and filtered to remove free carbon, are:

Gargoyle Mobiloil "A"
Gargoyle Mobiloil "B"
Gargoyle Mobiloil "D"
Gargoyle Mobiloil "E"
Gargoyle Mobiloil "Arctic"

They are put up in 1 and 5 gallon ***sealed cans,*** in half-barrels and barrels. ***All are branded with the Gargoyle, which is our mark of manufacture.*** They can be secured from all reliable garages, automobile supply stores, and others who supply lubricants.

VACUUM OIL CO.,
Rochester, U. S. A.

BRANCHES:

DETROIT Ford Bldg.	BOSTON 49 Federal St.	NEW YORK 29 Broadway
CHICAGO Fisher Bldg.	PHILADELPHIA 4th & Chestnut Sts.	INDIANAPOLIS Indiana Pythian Bldg.

Distributing Warehouses in the Principal cities of the world

A guide to correct Automobile lubrication

Explanation: In the schedule, the letter opposite the car indicates the grade of Gargoyle Mobiloil that should be used. For example, "A" means "Gargoyle Mobiloil A." "Arc." means "Gargoyle Mobiloil Arctic." For all electric vehicles use Gargoyle Mobiloil A. The recommendations cover both pleasure and commercial vehicles unless otherwise noted.

MODEL OF CARS	1909		1910		1911		1912		1913	
	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Abbott Detroit	...	...	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Alco	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
American	A	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Apperson	A	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Autocar (2 cyl.)	A	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.
" (4 cyl.)	A	E	A	E	A	Arc.	A	Arc.	...	...
Avery	...	...	A	E	A	E	A	A	A	A
Benz	A	A	A	A	A	A	A	A	A	A
Buick (2 cyl.)	A	A	A	A	A	A	A	A	A	A
" (4 cyl.)	A	Arc.	Arc.	Arc.	A	Arc.	A	Arc.	A	Arc.
Cadillac (1 cyl.)	B	A	...	...	...	...	...	...	...	...
" (4 cyl.)	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Cartercar	A	A	A	E	A	E	A	E	A	E
" Com'l.	A	A	A	E	A	Arc.	A	Arc.	A	Arc.
Case	...	...	...	...	A	A	A	Arc.	A	Arc.
Chalmers	Arc.	Arc.	Arc.	Arc.	A	Arc.	Arc.	Arc.	Arc.	Arc.
Chase	B	B	B	B	B	B	B	B	B	B
Cole	...	...	Arc.	Arc.	A	Arc.	Arc.	Arc.	Arc.	Arc.
Columbia	A	E	E	E	A	A	A	A	...	...
" "Knight"	...	...	...	...	...	...	A	A	A	A
Couple Gear	A	A	A	A	A	A	A	Arc.	A	Arc.
Daimler	A	E	A	E	A	E	A	A	A	A
" "Knight"	...	...	...	...	A	A	A	A	A	A
Darracq	A	E	A	E	A	E	Arc.	Arc.	Arc.	Arc.
De Dion	B	A	B	E	B	A	B	A	B	A
Delaunay-Belleville	B	A	B	A	B	A	B	A	B	A
Elmore	A	A	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	...	...
E. M. F.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	...	...
Fiat	B	A	A	A	B	A	A	A	B	A
Flanders	...	...	E	E	E	E	Arc.	Arc.	...	...
" (6 cyl.)	...	...	...	...	...	...	...	...	Arc.	Arc.
Ford	E	E	A	Arc.	E	E	E	E	E	E
Franklin	B	E	B	Arc.	A	Arc.	A	Arc.	A	Arc.
" Com'l.	B	A	B	A	B	A	A	Arc.	A	Arc.
G. M. C.	...	...	...	...	...	...	Arc.	Arc.	A	Arc.
Gramm	...	...	...	...	A	Arc.	A	Arc.	A	Arc.
Gramm-Logan	A	Arc.	A	Arc.	...	...	...	...	...	...
Herreshoff	A	A	Arc.	Arc.	A	Arc.	A	Arc.	A	Arc.
Hewitt (2 cyl.)	A	A	A	A	A	Arc.	...	...	...	...
" (4 cyl.)	A	E	A	E	A	Arc.	E	E	E	E
Hudson	...	...	Arc.	Arc.	A	Arc.	A	Arc.	A	Arc.
Hupmobile "20"	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
" "32"	...	...	...	...	...	...	...	...	A	Arc.
D H. C. (air)	...	...	...	...	...	...	...	...	B	A
" (water)	...	...	...	...	...	...	...	...	A	A
International	B	A	B	A	B	B	B	A	...	...

MODEL OF CARS	1909		1910		1911		1912		1913	
	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Interstate	A	E	A	E	A	Arc.	A	Arc.	A	Arc.
Isotta	A	A	A	A	A	A	A	A	A	A
Itala	A	A	A	A	A	A	A	A	A	A
Jackson (2 cyl.)	A	A	A	A	...	...	...	...	...	...
" (4 cyl.)	A	E	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Kelly	...	...	...	...	Arc.	Arc.	Arc.	Arc.	...	...
Kelly Springfield	...	...	...	...	...	...	...	...	Arc.	Arc.
Kissel-Kar	A	E	A	E	A	Arc.	A	Arc.	A	Arc.
" Com'l.	...	...	...	...	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Kline Kar	...	...	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Knox	B	A	B	A	B	A	B	A	B	A
Krit	...	...	A	A	A	A	A	A	A	A
Lancia	B	A	B	A	B	Arc.	B	Arc.	B	Arc.
Locomobile	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Lozier	A	A	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Mack	A	E	A	E	A	E	E	E	E	E
Marion	A	E	A	E	A	E	A	Arc.	A	Arc.
Marmon	Arc.	Arc.	A	E	A	Arc.	A	Arc.	A	Arc.
Matheson	Arc.	Arc.	Arc.	Arc.	A	A	A	Arc.	A	Arc.
Maxwell (2 cyl.)	E	E	E	E	E	E	E	E	...	...
" (4 cyl.)	E	E	E	E	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
" (6 cyl.)	...	...	...	...	...	...	...	...	Arc.	Arc.
Mercedes	A	E	A	E	A	E	A	E	A	E
" "Knight"	...	...	...	...	A	A	A	A	A	A

MODEL OF CARS	1909		1910		1911		1912		1913	
	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Mercer	...	...	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Michigan	...	...	Arc.	Arc.	A	Arc.	A	Arc.	A	Arc.
Minerva "Knight"	...	...	...	...	A	A	A	A	A	A
Mitchell	A	A	Arc.	Arc.	A	Arc.	A	Arc.	A	Arc.
Moon	A	E	A	E	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
National	A	Arc.	A	A	A	A	A	A	A	A
Oakland	A	E	A	E	A	Arc.	A	Arc.	A	Arc.
Oldsmobile	A	E	A	E	A	Arc.	A	Arc.	Arc.	Arc.
Overland	A	E	A	E	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Packard	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Paige Detroit	...	...	E	E	A	Arc.	A	E	A	E
Panhard	A	E	A	E	A	E	A	Arc.	A	Arc.
" "Knight"	...	...	...	...	A	A	A	A	A	A
Pathfinder	...	...	...	...	...	...	...	...	A	A
Peerless	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Pierce Arrow	A	Arc.	Arc.	Arc.	A	Arc.	A	Arc.	Arc.	Arc.
" " Com'l.	...	...	...	...	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Pope Hartford	A	E	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Premier	A	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Pullman	A	E	A	E	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Rambler	A	A	A	A	A	Arc.	Arc.	Arc.	Arc.	Arc.
Rapid	A	A	A	A	Arc.	Arc.	Arc.	Arc.	...	...
Rayfield	...	...	...	...	...	...	A	A	A	A
Regal	A	E	A	E	A	Arc.	Arc.	Arc.	Arc.	Arc.
Renault	A	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Reo	A	A	A	E	A	Arc.	A	Arc.	A	Arc.
S. G. V.	...	...	...	...	B	Arc.	B	Arc.	B	Arc.
Seiden	A	E	A	E	A	E	Arc.	Arc.	Arc.	Arc.
Service	...	...	...	...	A	A	A	Arc.	A	Arc.
Simplex	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Speedwell	A	Arc.	Arc.	Arc.	A	Arc.	A	Arc.	Arc.	Arc.
" "Mead"	...	...	...	...	...	...	...	...	A	Arc.
Stanley	D	D	D	D	D	D	D	D	D	D
Stearns	A	A	Arc.	Arc.	A	Arc.	A	Arc.	...	...
" "Knight"	...	...	...	...	...	...	A	A	A	A
Stevens Duryea	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Stoddard-Dayton	E	E	Arc.	Arc.	A	A	A	A	A	A
" "Knight"	...	...	...	...	...	...	A	A	A	A
Studebaker	A	E	E	E	A	Arc.	Arc.	Arc.	A	Arc.
Stutz	...	...	...	...	...	...	Arc.	Arc.	Arc.	Arc.
Thomas	E	E	E	E	E	E	A	E	...	...
Walter	A	E	A	E	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Warren Detroit	...	...	Arc.	Arc.	A	A	A	A	A	Arc.
White (Gas)	...	...	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
" (Steam)	D	D	D	D	D	D	D	D	D	D
Winton	E	E	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.

GARGOYLE

Mobiloil

A grade for each type of motor

ointments are sold and from which tubes, butter in desired quantities might be expressed from time to time. Because of the volatile fatty acids in the butter, linings of lead or copper would be objectionable and the tubes would likely have to be made of pure tin. Doubtless in carrying out this mode of packing and shipping considerable invention would be required in developing the package into the best form to conveniently serve the described purpose.

Safety in Travel

(Concluded from page 517.)

ultimate length to allow for cooling shrinkage, each rail being cut separately and to very exact measurement.

As the rails are rolled, a five-foot piece is cut off and subjected to a drop test. The top of the ingot, because of pipe and segregation, is presumably of poorer quality than the rest of the rails from that ingot, and the drop test is made from this upper section. The acceptance or rejection of any given heat depends upon this and other tests, which vary according to the particular specifications under which the rail is being rolled.

The subject of the cause of rail failure is one of the most important metallurgical questions in the whole field of engineering. Formerly it was believed that most rail fractures were due to pipe carried over into the rail from the ingot. To-day it is recognized that there are other causes, some inherent in the rail, more external, which account for most of the failures. Many split heads which were formerly supposed to be due to pipe are now believed to result from the wedging and splitting action of the heavy concentrated wheel loads of modern traffic. The writer was shown at the Sparrow's Point works a section of a rail which had developed a large vertical crack through the center of the head, which did not, however, extend to the top surface of the rail. This crack was caused undoubtedly by the cold rolling effect of the heavy concentrated wheel-loads, assisted, possibly, by a slight inclusion of foreign matter or some local segregation. The cold rolling effect is not unlike that of the ordinary rolling pin upon the baker's dough, and it takes place when the pressure exceeds the elastic limit of the head of the rail. In the specimen shown to us, the metal had been cold-rolled down into the crack which had opened up in the head of the rail, and the two halves of the head had been forced outwardly until on laying the template over the rail as thus spread, it was found that the head had been widened over 3/16 of an inch. This is a characteristic example of the so-called "split head" rail, which has become one of the most prevalent types of failure since the great increase in weight of rolling stock and high speeds.

The composition of 80-pound A. S. C. E. rails made at Sparrow's Point is depending upon the purchasers' requirements as follows:

	Bessemer.	Open Hearth.
Carbon	.40 to .50	.60 to .73
Chromium	.20 to .40	.20 to .40
Nickel, about..	.75	.75
Phosphorus ...	.055 to .07	.01 to .04
Silicon	.06 to .12	.08 to .12
Manganese ...	.75 to 1.00	.60 to .90

Rail Steel from the Electric Furnace.

At the time when the demand for a more reliable steel rail was at its height, an entirely new process for refining steel made its appearance on a small and experimental scale. Some French and German engineers attempted to produce a steel having the high qualities of crucible steel, by means of the electric furnace. It was thought at that time the cost of any such process, should it prove successful, would be so great that it would be available only for materials the demand for which was comparatively limited.

At about the same time the United States Steel Corporation decided to use its unlimited resources in investigating the problem and to determine what hope there was of using the electric furnace for the production of an exceptionally high-grade steel in the enormous quantities re-

quired to supply the demand for steel rails. The investigation was carried out systematically, step by step, and it is significant that up to the present time the cost of this practical study of the problem has reached nearly one million dollars. The results, however, have justified the expenditure of time and money, and we present illustrations of an electric furnace capable of treating at one time fifteen tons of steel, which has turned out material of such high quality, that already eight thousand tons of electrically-refined steel rails are in the tracks, and most of this has been in service from two to three years. During that time there has not been recorded a single case of breakage—certainly a most encouraging result.

From the photographs and the cross-section which are herewith reproduced, it will be seen that the furnace itself is somewhat similar in its construction to an open hearth furnace. It is so supported as to have a rolling and tipping motion from the charging to the pouring side, the movements being controlled by a powerful hydraulic cylinder. It should be explained here that electric furnaces are broadly of two types; first, induction furnaces, to which the heat is supplied by currents induced in the bath of hot metal, and secondly, arc furnaces in which the arc is struck between an electrode and the hot metal in the bath, or between two or more electrodes—the metal in the former case being heated only by the fierce radiation from the arc. The fifteen-ton furnace shown, which is at the South Chicago Works of the Illinois Steel Company, is of the former type. It is provided with three huge electrodes, each about two feet in diameter, which, as they are consumed, are fed down automatically, and maintained at the required distance from the surface of the metal. The charge for the bath is taken direct from the Bessemer converters, and the process of refining is as follows:

The phosphorus is removed in the basic electric furnace, in much the same manner as it now is in the basic open hearth furnace—by the use of lime and oxide of iron. The resulting slag containing the phosphorus is tapped off, and a new slag of burned lime and fluor spar is formed. When the slag is molten, coke dust is added, and the resultant carbide of calcium is produced. The free carbon, and, possibly, the carbide of calcium in the slag, with the aid of the carbon and manganese in the bath, eliminate the deleterious oxygen from the steel.

The valuable advantages of the electric over the Bessemer and basic open hearth processes are stated by:

"First, the more complete removal of oxygen; second, the absence of oxides caused by the addition, such as silicon, manganese, etc.; third, the production of electric steel ingots up to eight tons in weight that are practically free from segregation; fourth, the reduction of sulphur to 0.005 per cent if desired; fifth, the reduction of phosphorus to 0.005 per cent, as in the basic open hearth process, but with the important advantage that there is a complete removal of oxygen."*

Perhaps the most important advantage of the electrical process is that its product is practically entirely free from segregation—that prolific source of rail failure. Furthermore, the steel is almost perfect in structure, and when magnified one thousand diameters, it shows no oxide or slag inclosures, another advantage of priceless value. The South Chicago experimental and practical investigations give promise that ultimately all steel rails will be made by the electrical method.

The Problem of the Small Farm Tractor

(Concluded from page 519.)

the plow underneath the frame has the advantage of allowing a disk harrow or other implement to be attached close behind. When two plows are used, however, there is scarcely room underneath,

* Paper by William R. Walker, United States Steel Corporation, on the "Electric Furnace as a Means of Producing an Improved Quality of Steel."

and this advantage must be sacrificed. Not a few such outfits have two, three and even four plows in the rear, with provision for a power-lift, usually a chain and clutch-operated shaft.

Distributing the Weight.

Probably the greatest disadvantage of a combined tractor and plow, is the fact that the distribution of weight to get the best results in plowing, is not the proper distribution when the load is strung out on trailers in the rear. Plowing, however, is the job requiring the greatest power, and these other advantages may easily be regarded as of less importance than the securing of the greatest efficiency in plowing alone.

The great problem of side draft brings out some peculiar combinations. There has been a persistent effort on the part of designers to build a tractor with one drive wheel, thus placing the power directly ahead of the plow. One of these, which never reached the market, had a drive wheel at the right and rear, supporting the weight upon one front wheel at the right hand side, and a rear wheel at the left. Unfortunately, the distribution of weight was not properly caculated, and the rig earned the nickname "Tumble-bug" before it ever had a chance to plow a furrow.

A somewhat more successful application of the one-wheel idea was made with the traction wheel in front. A long triangular frame, supported at the rear by two steering wheels close together, carried three plows which were lifted by power and released by the foot. One advantage of this tractor was its ability to turn a square corner in plowing. However, it was a plowing machine pure and simple, making little or no pretense at doing general farm work. For this reason probably it was not a commercial success, and was never even advertised to the public.

The next step from the tractors already discussed, seems to be the home-made machine. In the SCIENTIFIC AMERICAN for February 1st, the picture of a home-made tractor was shown. Many farmers are mounting their stationary engines upon trucks made out of binder or mower wheels, with gear or chain drive and various crude mechanisms. Some motor manufacturers are alive to this situation, and are advertising motors to the men who want to build their tractors at home. On the other hand, several firms are offering trucks and sets of gears to farmers who wish to build their own machines, using the stationary machines they have already installed. It is needless to say that these make-shift outfits have all the economic disadvantages of the small tractor, and in addition, do not enjoy the advantages of shop design and workmanship. It is not difficult to make a tractor that will run, but it is so to make one that will meet all the requirements satisfactorily.

The Self-propelled Cultivator.

Just now, there is an outcropping of a type of machine which seems entirely logical, and in fact an advance of the tractor into a separate field from that which we have been discussing. This is the self-propelling light tractor designed merely for cultivating. Several concerns have made such tractors, not claiming them to be sufficiently powerful nor rugged in construction to do heavy plowing. These light machines consist essentially of two high drive wheels with a small steering wheel or trailer to balance the machine. It is claimed that one of these will turn from one corn row into the next and cultivate two rows of corn at one time, and is no harder to steer than a team of horses, and much faster.

At present the trend seems to be in the direction of even smaller cultivators, propelled by an engine of three to ten horsepower, the driver walking and steering the outfit. Out of all the tractors discussed in a previous article on foreign tractors and tillage machines, a motor of this type alone appealed to the writer as more practicable for the American farmer than what we already have. Since then, at least two concerns in the United States have started vigorously to advertise a similar cultivating machine.

One of these manufacturers advocates his tractor for handling a small turning-plow as well as a cultivator. A two-cylinder nine horse-power engine of the motorcycle type is used, and means are provided to use its power for grinding feed, pumping, etc., where desired. The outfit is very narrow, only twelve inches wide, thus allowing rows of intertilled crops to be placed close together. It is claimed to do the work of one two-horse plow or two one-horse plows, in the latter case cutting two furrows at once. The guiding is accomplished by means of a jointed portion of the left handle, which is connected with the axle of the traction wheel. By moving the handle to right or left, the axle is moved like that of a bicycle. The plow may be guided and the machine thrown in or out of gear, or the speed regulated without letting go of the handles.

The suction of the plowshare gives a remarkable amount of traction for the weight of the machine, which is 350 pounds. On striking an obstruction, the spiked drive wheels slip, so that the machine may be thrown out of gear. Only sixty-five pounds of the weight is lifted by the handles, and the obstruction may easily be passed. Two of the machines may be used together so as to convert the outfit into a riding plow. It also has a spraying attachment, and a cutter bar for mowing grass is being developed.

Another motor of this type is made with larger wheels to straddle a row. The manufacturers' catalogue is full of interest. It brings out the interesting fact that the farmer who owns an automobile could not afford to use his motor car long for either traction or belt work. The stationary engine, on the other hand, cannot be moved easily from place to place, and a portable engine frequently requires the use of a horse to pull it about. By making the small engine furnish its own motive power, the farmer may have this engine whenever he wants it, in the field or the wood-lot, in the barn, or even in the summer-kitchen laundry.

It is an impartial machine, working one day for the farmer and the next day for his wife. If there is water to be pumped, the tractor will go where the water is and pump it. Any make of small cultivator can be attached, and the tractor will work in the corn field or the nursery with equal convenience. The wheels are adjustable, so that the space between them may vary from 26 to 42 inches, so as to fit any width of corn rows. The left handle is the controlling factor, a slight turn engaging the clutch so that the tractor will move forward at any speed from 1 to 4 miles an hour.

Two belt pulleys are provided, one running at from 500 to 2,000 revolutions per minute and the other from ten to forty revolutions per minute. This of course simplifies the problem of supplying the pulleys for different machines. Further than this, a special shaft with the universal joint at either end is furnished so that the motor can be direct-connected with a generator, corn sheller, or feed mill. The outfit complete weighs 500 pounds and costs $265, or about what a real good draft horse will bring. There seems to be no reason why the mechanical difficulties should not be very easily solved in such a machine, nor why it should not prove extremely useful if care is taken to perfect it.

Some Interesting French Machines.

The automobile lawn mower is a familiar sight on large estates and in our parks. Several years ago a leading American manufacturer put out a gasoline mower, which was tried out on the farm of the late Senator Dolliver in Iowa. It, however, did not prove a success. At one of the recent French shows an auto-mower was shown, as illustrated in the accompanying photograph. It is not known what success has been achieved in the field. In the background of the same illustration is shown the small cultivator previously referred to as having appeared to be one of the few practical machines discussed.

Another new and interesting French model is illustrated with cultivator

shovels underneath the frame. The extension rims needed for soft ground are shown in the illustration on the ground, at the rear, the smooth wheels alone being used for road work. The traction wheels are close together in front, evidently for the purpose of allowing them to go between two rows, while the outside wheels straddle them.

The Optimistic Small Manufacturer.

From these instances it seems that a great deal of attention is being paid by all classes of men to the working out of tractors for the small farm. The fact that no great commercial success has been achieved is not to be taken as discouraging. The foremost companies, with reputations built up on larger tractors, are slow to risk their reputations behind something which may not prove a good farm investment, even though mechanically reliable. The smaller manufacturers and the inventors are more optimistic and are apt to rush into print at the first indication that their product is at all feasible. This arouses an unfounded doubt that the larger manufacturers are making no attempt to solve the problem. The chances are however that, within a reasonable time, one or more will have reached the solution in so far as the question may be solved permanently and satisfactorily.

There is no question that the market for a successful small tractor is beyond all comprehension. The delay in reaching the solution, therefore, may argue that farm conditions will have to be changed to meet the limitations of the tractor. Our manufacturers have successfully solved the problem of the big tractor for the big farm. In Europe, where the farms are nearly all small in size, attention has been concentrated for a longer time on the small tractor. Still, as stated in a previous article in the SCIENTIFIC AMERICAN, European manufacturers have not met the needs of the small farmer. Not one idea that has been advanced in this direction by European designers, seems to have escaped a trial on this side. On neither side of the water has the ideal been reached. However, more thought is being expended upon this one problem than on any other farm machine of the present day. If a small tractor can be built, it is certain to be built within the near future.

What is Required of the Small Tractor.

The small tractor must do all that a big tractor can do in stationary work. It must also plow, harrow, and even cultivate. It must do cheaply the kind of work that would require only one or two horses. It must really do away with the horse, to justify the investment. It must do fairly heavy work and still be economical for light work. It must be part tractor, part horse, part automobile, part wagon and almost animal-like in its versatility. It must be able to run on full load longer than a horse can, and because it is insensible, it is more apt to be overloaded. It will not stand as great an emergency load as the horse, yet it must get out of the same difficulties. The designer must provide an excess of power for emergencies, and yet in some way discourage its constant use.

It is a hard problem, and one which has so far resisted solution with one universal type. If the solution is to come it will undoubtedly come in two ways; first, the work of even the small farm will be divided into classes and specially adapted machines provided for each class of work; second, it will finally be recognized that the tractor calls for a complete reorganization of the farm. As the cost of farm operations increases, the necessity for cutting costs will very probably result in a general increase in the size of farm units and the continued sway of a tractor of moderate size—one agronomically feasible and one which will provide continuous employment for the hundreds of alert tractioneers that are now preparing themselves for the new calling.

Safety Construction of Steamboat.—Frank Savon of Buckhannon, W. Va., has secured patent No. 1,056,840, for a steamboat which has a lower section and an upper

section with the lower section readily detachable from the upper section and normally held together by suitable means. The upper section is provided with a plurality of wells through which smokestacks and staircases carried by the lower section project. In case of accident the lower section may be dropped from the upper section so the latter can serve as a life raft.

The Government Document Office

WHEN a publication house sends out in the neighborhood of one million publications each week, it must have an up-to-date equipment and all obtainable labor saving devices. The Superintendent of Documents, August Donath, who has charge of the distribution and sales of the public documents issued by the various departments at Washington, is proud of the equipment by which his force of one hundred or more employees are able to handle the tremendous output of his office. But while this equipment includes automatic mail sackers, envelope sealers, and addressing machines, the actual wrapping is performed by hand. It is said that Samuel B. Donnelly, the Public Printer, has sought far and near for a suitable, practical wrapping machine and has made many trips to inspect and investigate proposed automatic apparatus which promise to do the work, but has not yet found a machine which possesses the flexibility of structure and operation to enable it to function satisfactorily in wrapping and sealing pamphlets and other publications varying in size and thickness. A machine which would meet the demands of the Superintendent of Documents would, it is thought, suffice for any publishing house, and the field should be an attractive one for inventors, especially those experienced in the wrapping machine art.

Industrial Alcohol

IN the manufacture of industrial alcohol the aim has been to find a cheap raw material and to increase the yield by improved methods of mashing and fermentation. Mashing is the process of saccharifying the starchy material into fermentable sugars, maltose and dextrin. The mash is now fermented by means of yeast, the enzyms of which split maltose into dextrose and then into alcohol and carbonic acid gas. Theoretically one pound of starch should yield 0.57 pound or 11.5 fluid ounces of alcohol. In practice this yield is never obtained, but falls at least 15 per cent below it.

This low yield is due to incomplete saccharification and fermentation, and the production of by-products such as glycerin and succinic acid in the fermenting vat. In the brewing of beer the aim is not to ferment all the fermentable matter in the beer wort, but to leave considerable extract in the finished beer. The boiling of the wort, which kills the enzyms of the malt, is, therefore, no objection. The distiller, on the other hand, aims to completely ferment the maltose and dextrin. He depends on the enzymic action of the malt to break down the dextrin into maltose in order to enable the yeast, which cannot directly attack the dextrin, to ferment the same after its conversion into maltose.

It may be remarked here that the complex starch molecule is gradually broken up into dextrin, malto-dextrin and maltose by the action of the malt enzym. Therefore, it will not do to sterilize the distiller's mash by boiling, as this would destroy the malt enzym on which the distiller depends for his dextrin inversion. But in the unsterilized mash the yeast must carry on a struggle for existence with a multitude of wild yeasts and bacteria which set up undesirable fermentations of their own.

There are as many varieties or races of yeast as there are varieties of apples. While Luther Burbank has given the world new varieties of fruits of all kinds, and by skillful breeding has greatly changed the characteristics of certain plants, mycologists have done similar work with yeast. The aim of the distiller is to find a yeast producing a clean fermentation, that is one yielding none but alcohol and carbonic acid gas as its

products. The yeast must be able to survive and do its work in mashes rendered slightly antiseptic. Yeast races have been acclimated to antiseptics by propagating them in nutrient media to which increments of antiseptics, such as hydrofluoric acid, have been added. Such a hardy race of yeast will do its work in antiseptic mashes in which the ordinary wild yeasts and bacteria are unable to survive.

The other object of the distiller is to find a cheap raw material. Germany has it in the potato containing 12 to 27 per cent of starch. In America the price of potatoes quite precludes their employment. Corn, containing about 70 per cent of starch, would be an excellent material, but its price has greatly risen in recent years, selling at present for about 60 cents a bushel of 56 pounds in the western corn producing States, and its average price for some years past has been 40 cents. Pioneers in Nebraska remember the time when it was cheaper to burn corn as fuel than bituminous coal. Corn at that time sold considerably below 20 cents. Even in the 90's 25 cents was considered a good price. The present price of corn as raw material for industrial alcohol is, therefore, prohibitive.

As early as 1854 attempts were made to use wood as raw material. Sawdust boiled in dilute acid will become converted into sugar, dextrose, according to the equation:

$$C_6H_{10}O_5 + H_2O = C_6H_{12}O_6$$

Cellulose + water = dextrose.

Dextrose, of course, can be fermented by yeast to produce alcohol. Unfortunately, the reaction does not take place as readily as the above formula would indicate. Prolonged boiling with fairly concentrated acid is necessary to convert the larger part of the cellulose into dextrose. The method is laborious and expensive, but the day may not be far distant when the difficulties will be overcome, and it will be a commercial success.

Very recently a good deal of work has been done to utilize the waste sulphite liquors from paper mills. In the manufacture of paper the wood is digested under pressure with a solution of calcium bisulphite. The waste sulphite liquor coming from the digesters is a dark, ill-smelling liquor which contains among a variety of other ingredients carbo-hydrates derived from the wood. After neutralization of the acid and other preliminary steps, the liquid is rendered suitable for fermentation by yeast. In Sweden thousands of gallons of alcohol are annually produced from such liquors, and no reason is seen why the sulphite liquors in this country cannot be similarly utilized. Sulphite liquor is a waste product, pure and simple, is difficult of disposal and a nuisance when allowed to pollute the streams; its utilization would, therefore, be not only an economic gain, but would also abate a nuisance in many places.

The alcohol obtained from wood or waste sulphite liquor by fermentation with yeast must not be confounded with wood alcohol obtained from the destructive distillation of wood.

It may be of interest to state here that alcohol can be made from ethylene C_2H_4, a gas contained in coal gas, by treatment with sulphuric acid. This artificial production has, at the present time, only experimental value.

Helps the Paper Hanger.—Patent, No. 1,058,159, to William H. Decker of Youngstown, O., who assigned one third to Emmet S. Decker of the same place, is for a paper-hanging device in the form of a rectangular frame carried at the top of a pole with one side of the frame open so that the edge of a roll of paper may be exposed for matching purposes. Another patent, No. 1,058,185, to James Krondak of Morse Bluff, Neb., is also for a paper-hanging device in which there is a frame having a roller at one end mounted in a frame which is pivoted for purposes of adjustment, so the roller can be set with relation to the paper to be hung, while the frame has at its end opposite the roller means for holding the paper taut.

NEW BOOKS, ETC.

PSYCHOLOGY AND INDUSTRIAL EFFICIENCY. By Hugo Münsterberg. Boston: Houghton, Mifflin Company, 1913. Price, $1.50.

Prof. Münsterberg writes in his customary rather self-satisfied vein. But despite the irritation which his style arouses his book is of undeniable value. The work of the efficiency engineer is not sufficiently recognized to our mind, and the importance of the experimental psychologist's is exaggerated. He questions Harrington Emerson's statement that "the competent specialist who has supplemented natural gifts and good judgment by analysis and synthesis can perceive aptitudes and proclivities, even in the very young, much more readily in those semi-matured, and can with almost infallible certainty point not only what work can be undertaken with fair hope of success, but also what slight modification or addition and diminution will more than double the personal power." Of this he rather disapproves, despite the fact that workingmen are now engaged according to Dr. Blackford's system with astonishing success. Too much stress is laid upon the value of experimental tests in determining vocational fitness. Much more is required. A man may respond splendidly to reaction time tests, and may be able to distinguish colors with accuracy, but yet may be hopelessly unfit to drive a locomotive engine, simply because he is not steady and cautious. In other words, the type of man to be selected for a particular position plays no part in Münsterberg's scheme. Instrumental analysis does not disclose whether a man is a trouble maker, whether he is pugnacious, whether he is easy going, whether he is companionable, or whether he is a born leader. All that it does is to show whether or not a type once selected, wrongly or rightly, has good senses and how responsive it is to sense impressions. We cannot conceive of any psychological test which would inevitably enable us to pick out the best salesman out of five hundred men. But we can conceive of a scientific study of character which would enable us inevitably to select the right man. In other words, what Prof. Münsterberg seems to overlook is the fact that instrumental analysis is not an indication of character.

ERGÖTZLICHES EXPERIMENTIER BUCH. Von Albert Neuburger. Berlin, Wien: Ullstein & Co., 1911.

This is a book of scientific experiments which is intended to be not only instructive but amusing and entertaining. While the experiments are old, many of them having been brought to the notice of amateurs by the late Gaston Tissandier, they have been very ingeniously arranged and entertainingly described. Some idea of the character of these experiments may be gleaned from their titles: "Cardboard as a Cutting Instrument," "Raindrops from Grease," "Blowing through a Brick and Putting Out a Light," "The Insensitive Coin, Leaping Papers, Frogs and Devils," "The Perforated Penny," "The Magic Egg," "Cannons that Shot without Powder," "Ice That Cannot Be Cut," "June Bugs and Bacteria Lamps," "The Laughing Mirror," "Tricks With Sealing Wax." To the experiments with which amateurs have been acquainted through popular books for some years, there have been added many new experiments based upon the more recent discoveries in science. The book can be highly recommended to German-reading lovers of experimental science.

VOLAMEKUM. Handbuch fuer Luftfahrer. Von Ansbert Vorreiter und Hans Boykow. Munich: J. F. Lehmann's Verlag, 1913.

This is an admirable little handbook of practical information for the aerial navigator, whether he sails the air in a balloon, a dirigible, or an aeroplane. No better evidence of the growing importance of aerial navigation can be presented than the publication of such a practical guide book. The little volume first of all tells us something about the handling of free balloons, and then passes to a discussion of the handling of airships and flying machines. Much space is devoted to navigation, both terrestrial and astronomical. A very complete description of the more important instruments that can be used to guide the navigator of the air is presented. Valuable, too, are the tables and diagrams which give much information on the quantity of gas necessary for inflation, the pressure of gases, the quantity of ballast required, the geographical position of German cities, the hours of sunrise and sunset, etc. Since the European navigator finds it no difficult task to overstep the boundaries of his own country, the final chapters of the book are devoted to telegraphic signals, telegraph tariffs, postage rates, coin values, and a dictionary of the more common phrases in several European languages.

STEEL. Its Selection, Annealing, Hardening, and Tempering. By E. R. Markham. Fourth edition, fully illustrated. New York: The Norman W. Henley Publishing Company, 1913. Price, $2.50.

This is a new edition of a book which was formerly known as "The American Steel Worker." Since the advent of the automobile, the modern gas engine, and the flying machine has brought about a demand for extremely tough, strong, high-grade steels of various kinds, it became necessary to rewrite portions of the book. As it stands the work may be regarded as a good textbook on hardening, tempering, and annealing steel of all kinds, and is a good set of comprehensive and specific instructions on the methods of hardening a large number of tools.

ORIGIN OF ARCHITECTURAL DESIGN. By Lee H. McCoy. The Antiquarian Publishing Company, Benton Harbor, Mich., 1912. 8vo.; 168 pp.; illustrated. Price, $1.

ELECTRONS AND THE ELECTRONIC THEORY are discussed by Sir Oliver Lodge in Scientific American Supplements 1428, 1429, 1430, 1431, 1432, 1433, 1434. Price 10 cents each. For sale by Munn & Co., Inc., and all newsdealers.

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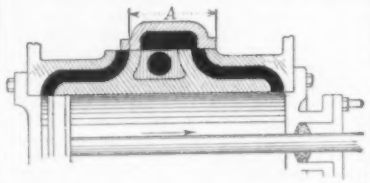
(12810) C. L. W. calls attention to a trouble he has had with his wireless apparatus, due to insects creeping in between the plates of his condensers, thus upsetting the balance of the adjustment. This may sometimes occur, and in case any fault exists which seems unaccountable, we would suggest that amateurs look for the bug

(12811) H. H. asks: A says that the pressure on the back of an ordinary slide valve used on steam engines is equal to the size of the ports. B says it is equal to the total area of the valve. Of course, we have reference to the pressure causing the friction between the valve and the seat. Who is right? If steam ports were plugged perfectly steam tight, would boiler pressure, say 150 pounds, force the valve against



the seat as if there was that much pressure to the square inch of the valve? A. The pressure on the steam-chest side of a slide valve may be taken to be the steam pressure times the area of the slide in square inches. The back pressure in the exhaust port is so variable that it should be ignored. When the outside lap hangs free is practically the only time the pressure is not taken on the entire valve area. In that case, the area of the sketch is the one used.

(12812) M. L. writes: I can remember space I saw inside a soap bubble fifty years ago. This particular space is fixed in my memory. Turning to astronomy, I also find it is fixed in the earth's path, over thirty b'll on miles away from this written reference. Does memory then retain immortal form in space through which the world has moved? The subject is well worth investigation by every one. All details of former position in space can be identified in relation with any written or other distinguishable landmark and correspondence. Concerted inquiry is needed to secure agreement as to terms for representation of standard events. A. It is possible to think of any point of time or space at any moment, whether we have ever seen or known that point before or not. We can imagine the action going on at that point, and write a description of it. Such are many works of fiction, such as Jules Verne's "Twenty Thousand Leagues Under the Sea." The doctrine of Relativity, which is commanding much attention at the present time, is involved in this conception. You will find this discussed in our SUPPLEMENT Nos. 1917 and 1891, price ten cents each.

(12813) H. K. asks: How can a spectral analysis be employed to prove that the planets, the sun, and the remotest fixed stars are composed of matter identical to that of our earth, and how is this done? A. The lines in the spectrum of a substance are always in the same position; and when in the spectrum of a heavenly body the same lines are found in the same position as upon the earth, it is known that that substance is present in that body. For this see any textbook of astronomy. We can send you Todd's "New Astronomy" for $1.45 postpaid. 2. How can the distance of very remote stars be ascertained w.th reasonable accuracy? Kindly give a geometrical illustration, if possible. A. The distance of a star is found by its parallax, which is its displacement as viewed from different parts of the earth's orbit. An illustration of this is in the displacement of a flagpole as we walk in a circle around it. This is also to be found in the book to which we have referred you above. 3. How far has it been proven that every star (fixed star, our sun, etc.) rotates on its axis and revolves in its orbit around some center, as do the planets of our solar system? A. It has not been proven that stars rotate upon their axes. They are too distant for such a motion to be detected.

(12814) J. S. V. asks: Will you please tell me which is correct? I claim it takes more power to pump water in a tank with pipe running to top and flowing over than to run to the bottom of tank, as there is no pressure on the pipe at the bottom, only the size of the pipe the depth of water in tank. A. If the level of water in a tank varies, sometimes being very low and at other times full, it will require less power if the inlet pipe enters at the bottom, since the pressure is that of the size of the pipe and the depth of the water. If the tank were always full it would not make any difference whether the inlet was at the bottom or the top of the tank. Under a constant head the pressure would be the same,

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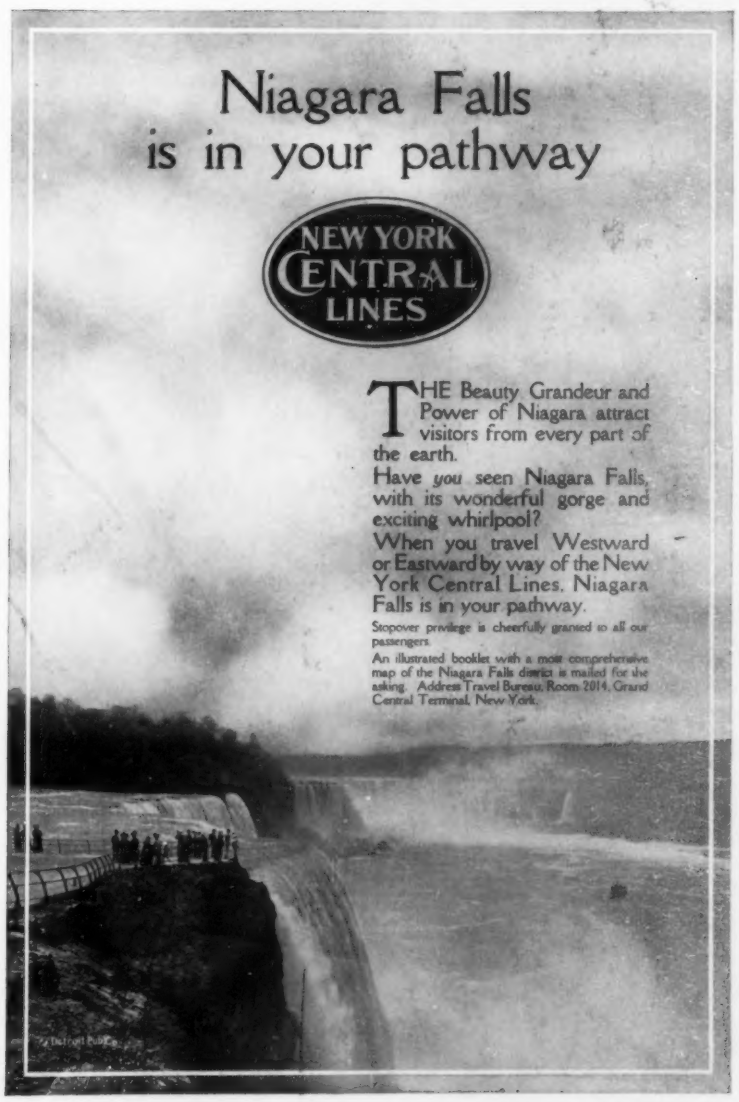

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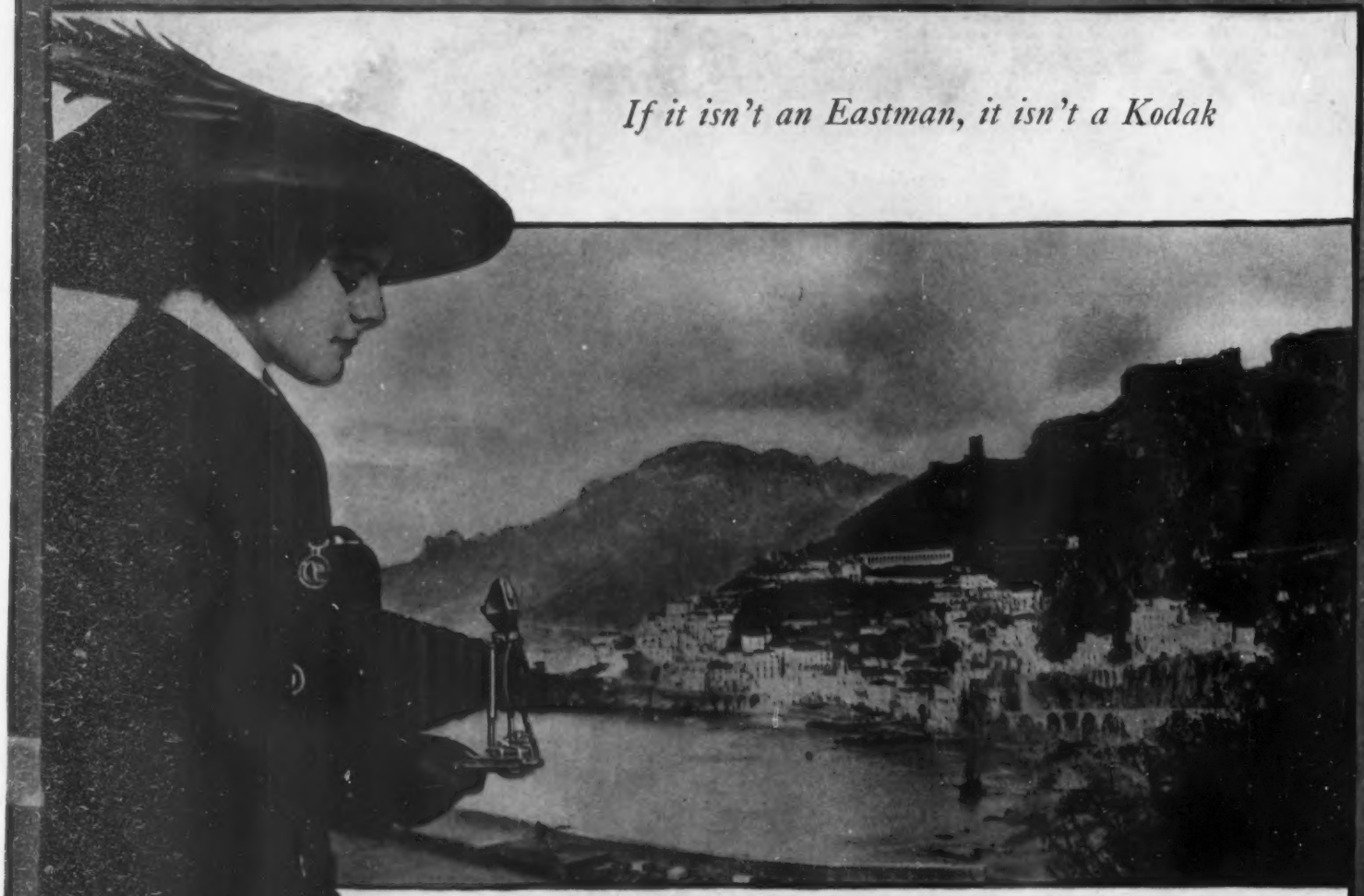

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